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ABSTRACT

Included are four units related to coastal and oceanic awareness. The units are: (1) The Muskrat; (2) The Not-So-Common Oyster; (3) The Horseshoe Crab; and (4) The Blue Crab. All four units are designed for elementary school students. Each unit contains teacher background materials, student activity materials, evaluation materials, transparency masters, and selected references. (RH)

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THE MUSKRAT

A Learning Experience for
Coastal and Oceanic
Awareness Studies

Produced by

MARINE ENVIRONMENT CURRICULUM STUDY
MARINE ADVISORY SERVICE
UNIVERSITY OF DELAWARE

and

POPULATION-ENVIRONMENT CURRICULUM STUDY
COLLEGE OF EDUCATION
UNIVERSITY OF DELAWARE

as part of a

PLAN FOR ENVIRONMENTAL EDUCATION

Fall 1974

SE 022 665

Please send evaluations

of learning experiences

to

Dr. Robert W. Stegner, Director

COAST Project

310 Willard Hall Education Building

University of Delaware

Newark, Delaware 19711

Supported in part by

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TITLE: THE MUSKRAT

* CONCEPT: I.B.4.a.(3)(a)

I. The earth is a finite natural system.

B. All living things have arisen from and are dependent upon the natural system of the earth.

4. The interaction of organisms with their environment leads to great diversity and wide distribution of organisms.

a. Natural selection leads to evolution.

(3) Natural selection results from the interaction of individual variations with environment.

(a) PLANTS AND ANIMALS TEND TO BE SUITED TO THEIR ENVIRONMENT.

** MARINE CONCEPT: 3.21

3. Marine organisms interact in complex ecosystems.

3.2 Marine organisms are adapted to their environments in different ways.

3.21 MARINE ORGANISMS ARE ADAPTED DEVELOPMENTALLY, STRUCTURALLY, FUNCTIONALLY, AND BEHAVIORALLY TO THEIR WAYS OF LIFE.

GRADE LEVEL: 2-4

SUBJECT: Science

CLASS PERIODS: Various

AUTHOR: Richardson, Fleming

* From A Conceptual Scheme for Population-Environment Studies, 1973. Cost $2.50.

** From Marine Environment Proposed Conceptual Scheme, 1973. No charge.

Both conceptual schemes are available from Robert W. Stegner, Population-Environment Curriculum Study, 310 Willard Hall, University of Delaware, Newark, DE 19711.

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I. Instructional objectives.

At the conclusion of this unit the student will:

A. Be able, after a field trip, to recognize and describe muskrat habitat.

B. Realize that because of structural adaptations of the ears, nose, feet, tail, and body covering, the muskrat is well suited to a life in and near water.

C. Recognize that muskrat food habits are adapted to wetlands life.

D. Be able to describe the structure of the muskrat's lodge or burrow.

E. Write an informative paragraph about the muskrat reflecting some independent research as well as the class research.

F. Present an oral report with illustrations relating to the class field trip.

II. Teacher background.

The muskrat is a large rodent familiar to streams and marshes throughout most of North America. The name is derived from the fact that it gives off a musk-like odor. Adults average about 12 inches in length with a nearly hairless tail of about 8 inches. Muskrat pelts are highly desirable for fur coats. The soft, uniform dark brown underfur is overlaid by long dark guard hairs, making the coat warm, dense, and waterproof.

The muskrat is well suited to aquatic life in other ways. It has ears and nose equipped with valves that shut tightly under the water. A good supply of air can be carried in its lungs, enabling it to stay under water for as long as five minutes. The muskrat, although rather slow on land, is an agile diver and swimmer. Its hind feet are partially webbed like those of many water and shore birds. It has long nails suited for digging. The bi-laterally flattened tail is used in swimming and allows greater speeds than could be obtained by use of the feet alone.

The open water muskrat house is built of available marsh plants plastered together with mud and is usually placed in water about two feet deep. An accumulation of vegetation forms the underwater portion, and a dry chamber of the same materials is built slightly above water level. Entrance passageways are underwater. As many as 10 individuals may use one lodge. Smaller individual feeding houses are often constructed so that food may be transported and eaten in comparative safety. The muskrat can also excavate a home in the bank of a stream or lake. Such a burrow consists of a central chamber with a number of underwater entrances.

The muskrat is essentially a vegetarian, but a very small portion of the diet is animal food. This may include fish, freshwater mussels, insects, crayfish, and snails. Plant material eaten by the muskrat consists largely of the stems and rootstocks of marsh plants. In one wildlife refuge, muskrats were observed to feed on the following plants in all seasons: cattail, burreed, cutgrass, rice, arrowhead, waterlily, and panicgrass. During the winter, waterlily or cattail roots make excellent food for the muskrat since they have a high starch content. Muskrats do not hibernate in winter but carry on their normal feeding activities beneath surface ice and in the warmth of their lodges or burrows.

Young are produced in litters any time between April and September. The blind, naked, helpless young, weighing about an ounce, are born in a dry house nest or burrow after a 30-day gestation period. The number in a litter varies considerably, 5 being an average number; each female will have 2 or 3 litters a year. The young muskrat reaches adult size in 6 to 7 months.

A muskrat with adequate food and water is not inclined to travel far and will remain within 200 yards of the lodge. However, erratic migrations, or dispersals, do occur. The factors that cause dispersal are not always known. Sometimes an obvious antagonism develops between parents and young as the young approach adult size. In other instances fighting between adult individuals can force one adult to leave the home area. In studies of muskrats in Iowa marshes, dispersal was found to be one of the most important mechanisms for population regulation. Each spring the young muskrats are driven from the lodges by the adults and unless they can find unoccupied ground within the home marsh are forced to travel over difficult terrain in search of space in other marshes. These individuals in transit easily fall to predators or succumb to accidents of various kinds. Muskrat enemies include owls, hawks, mink, otter, and most of all, man, the hunter and trapper. As is the case with most wild animal species, the majority of muskrats born will never reach adult size.

There is no better method for studying wild animals than going outdoors into the area where the animals live, observing them and recording these observations on tape and in a notebook. To aid in observation, field glasses and spotting scope are useful but not essential. Take a cassette recorder along on field trips. This is valuable where there is much to be observed and because primary grade students are not able to take very complete notes. The tape can be played back in the classroom to remind students of the observations they made in the field.

A suitable wetlands area or lake or stream where muskrats are abundant, possibly in a wildlife refuge, should be selected and visited by the teacher in advance. The refuge biologist in a National Wildlife Refuge is a very valuable resource person.

III. Presentation of material.

A. Teacher preparation.

1. Duplicate pre-test, unless questions are to be written on chalkboard.

2. Duplicate the drawings included in lesson packet for use as individual handouts, possibly to be colored and included with the paragraph reports students will prepare. Also, these drawings can be made into transparencies.

3. Obtain, if possible, a muskrat pelt or an item containing muskrat fur so that the students may see the color and feel the texture.

4. Select the field trip location and make all necessary arrangements.

5. Obtain all special field trip equipment.

6. Visit the field trip location to get an idea of plants and other animals, or sign of animals, which are likely to be seen by the class. If permitted, collect samples of the most abundant plant materials.

7. Obtain from the school library or other sources, any books containing pictures or information about muskrats as well as other forms of marsh life. (see p. 13 for an extensive listing of possibilities.

8. Obtain a film loop, filmstrip, or film, if desired.

B. Introducing the unit--classroom activities.

1. Explain that all living things which are not plants belong to the group called animals. (It is important that the students understand that the word animal does not mean mammal) Ask the students to name some animals. Guide the discussion so that lower phyla containing less common invertebrates are not neglected. The students will probably already be aware of the fact that insects, fish, amphibians, birds, and mammals are all animals. Explain that mammals and birds are warm-blooded animals, meaning that the body temperature is constant. All other animals are cold-blooded, meaning that the body temperature changes with the temperature of the surroundings. Relate this concept to the human average body temperature of approximately 98.6° F.

2. Write the word muskrat on the chalkboard. Guide the class in making the decision that this is the name of a warm-blooded animal - a mammal. Guide analysis of the origin of the name.

3. Give the pre-test.

4. Show the picture (or transparency) of a muskrat and the muskrat pelt (if available). Discuss the muskrat. Guide analysis and discussion to include the following:
   a. Classification - mammals,therefore warm-blooded.
   b. External physical characteristics - ears, eyes, nose, fur, tail.
   c. Habitat - discuss a marsh in general terms. Show cattails or other marsh plants. Discuss other animals, or signs of animals, the class may see. This will depend upon the season of the year in which the trip is being made; e.g. in spring one would expect to see red-winged blackbirds, common crows, common grackles, possibly some marsh birds and wading birds, probably Mallard and other ducks, frogs and frog and toad eggs, some insects, rabbits, and probably raccoon and deer tracks in the upland areas.
   d. Methods of locomotion - discuss the roles of feet and tail.
   e. The muskrat lodge or burrow - Show the drawings (or transparencies) of the muskrat house and burrow. Let the students speculate on the construction of each.

   Leave some of the students' questions for discussion during or following the field trip.

5. Show a filmloop, filmstrip or film if an appropriate one has been obtained.

6. Discuss the forthcoming field trip. Suggest appropriate attire, footgear in particular. If field glasses are to be used with this age student, some practice in their use in advance of the trip is strongly recommended. A spotting scope through which the students may take turns looking is most likely the simplest form of magnification.

C. Field trip.

1. Equipment needed.
   a. Cassette recorder
   b. Notebook and pencil
   c. Field glasses and spotting scope, if available and desirable.

2. Activities in the field.
   a. Observe the general characteristics of the area. Note:
      1. water
      2. transition areas
      3. upland areas

b. Examine plant life and note position of types of vegetation in relation to 1) open water 2) upland areas. Discuss with class; teacher make notes.

c. Look for animals or signs of animals; e.g. tracks, droppings, pellets, bones, feathers; look for insects, and other invertebrates in or near water.

d. Observe muskrat lodges as closely as practicable as to: 1) Details of construction 2) any muskrat activity.

e. Discuss special structural adaptations the muskrat has for life in this habitat. Discuss the methods he uses for locomotion.

f. Using the visible surroundings as clues, discuss the muskrat's food.

g. Using the tape recorder allow students to contribute observations and impressions relating to a. through f. above.

3. Timing

Since the attention span of this age student is usually fairly short, the entire stay in the field situation should not exceed 60 minutes unless other activities are planned.

D. Field trip follow-up - classroom activities.

1. Play the tape recording of class observations.

a. Note major points on the chalkboard.

b. Have the students assist in organizing these according to 1) general description of field trip area 2) Description of plants 3) evidence of animals other than muskrat (muskrat's neighbors) 4) observations of and conclusions about muskrat life.

1), 2), and 3) should be very briefly outlined. The emphasis in detail should be on 4).

2. Introduce students to all other resources which have been assembled in the classroom. Allow periods of time for individual research.

3. Have each student write a paragraph about the muskrat, including the following:

a. Very brief description of the animal

b. Where it lives

c. How its house is constructed

d. What it eats

4. Have each student prepare and present, with an illustrative original drawing, a brief (a few sentences) oral report on the topic "An Interesting Thing I Saw on the Field Trip."

5. Optional activity: Have each student assemble a booklet about the muskrat including 1) cover 2) his paragraph about the muskrat 3) original drawings about the field trip, 4) hand-outs, if used.

6. Special art activity: As a class project, make a model of a small pond. It can be made to show both summer and winter conditions. The pond in summer can be simulated by using a piece of blue cellophane. Cover the cellophane with a pane of glass to give the effect of ice in winter. A muskrat lodge, trees, and bushes could be made of twigs or dried grasses. Marsh plants can be made the same way. Animals can be made of papier mâché or clay. To add to the pond in winter, the display may be covered with soap flakes or snow flock.

7. Optional social studies activity: Discuss the economic significance of the muskrat. The trapping or hunting of muskrats for their valuable pelts, and sometimes their meat, provide the principal income for some persons and a supplemental income for many others in the eastern coastal regions of the United States.

E. Evaluation of pupil progress.

A comparison of the written paragraph and oral report with the pre-test should give adequate indication of increase in knowledge of subject matter for each individual student. Contributions to observation and discussion in the field and following the trip should also be considered.

Pre-Test

1. What color is a muskrat?

2. Where is the muskrat's home?

UNDERLINE THE CORRECT ANSWER

3. The muskrat is able to move fastest by (walking, swimming).

4. A muskrat eats mostly (plants, animals).

WRITE YES OR NO AFTER THE STATEMENT.

5. The muskrat is a warm-blooded animal.

6. The muskrat's tail is long and almost hairless.

Answers to Pre-Test

1. Uniform dark brown above; underparts are grayish . Most students would answer simply brown.

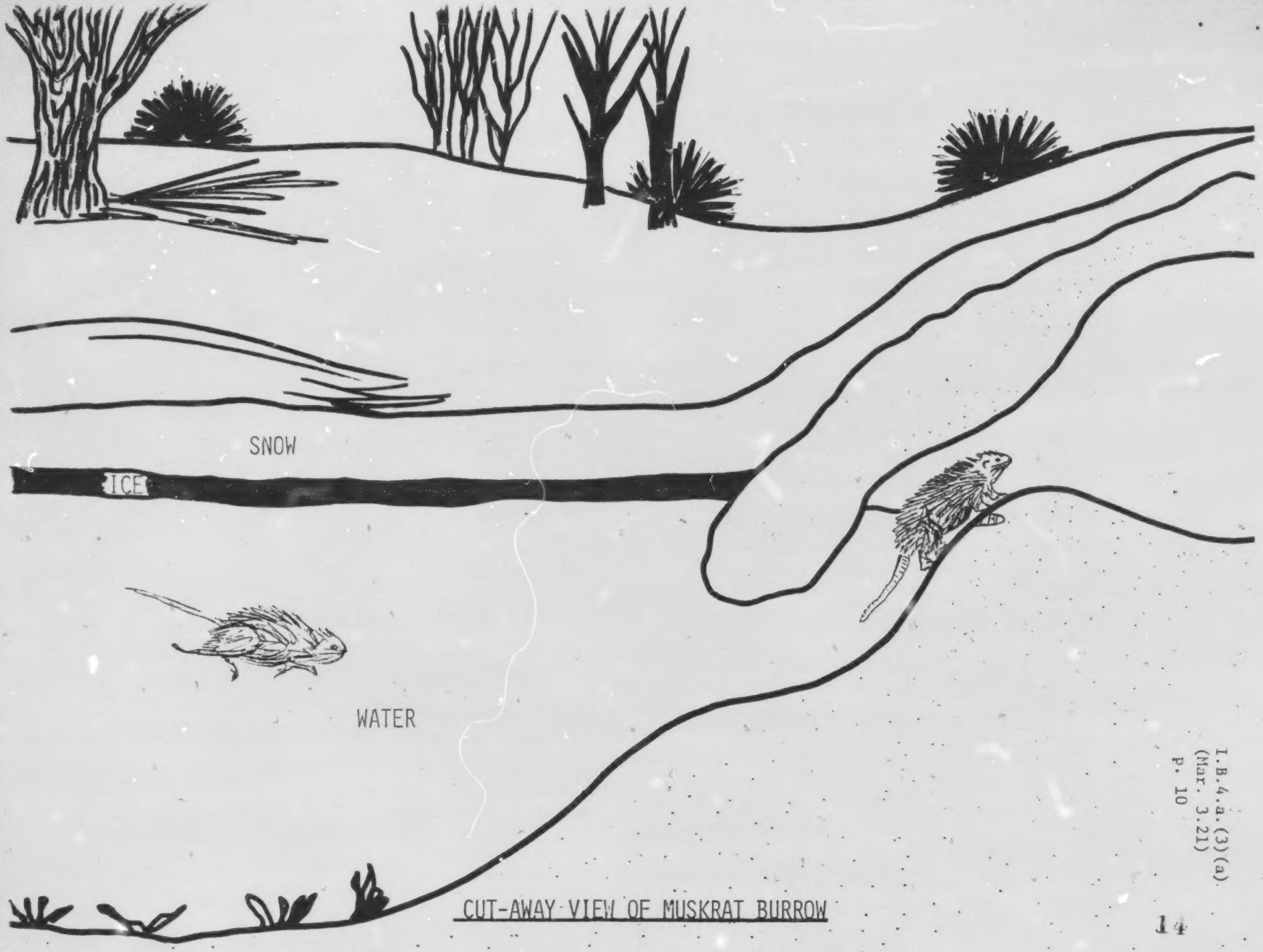
2. In a mound of plant stalks; in a shallow water area; or in a burrow in the bank of a stream of lake, or simply in water; or in a marsh.

3. swimming

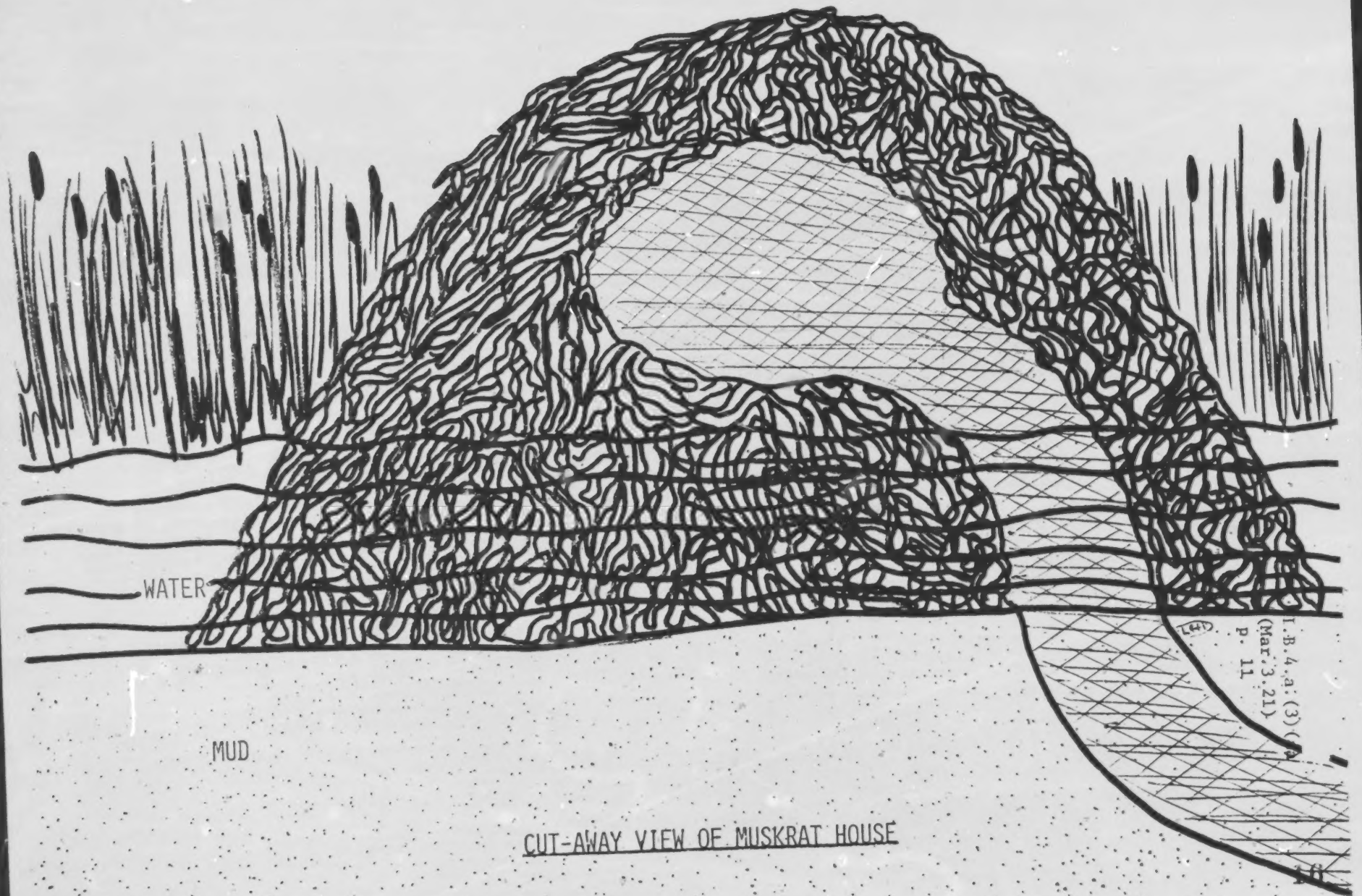
4. plants

5. yes

6. yes



CUT-AWAY VIEW OF MUSKRAT BURROW



CUT-AWAY VIEW OF MUSKRAT HOUSE

I.B.4.a:(3)(a)
(Mar.3.21)
p. 11

MUSKRAT

I.B.4.a.(3)(a)
(Mar. 3.21)
p. 12

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Language Arts Activities Supplement

#108 THE MUSKRAT

Unit Overview: The muskrat's habitat and life-style are presented with the aid of class activities, a field trip, and follow-up. Background on the muskrat is provided for the teacher. The unit contains pre- and post-tests, an extensive bibliography, and three transparency/handout masters of the muskrat and its burrow.

Grades 1-3

Individual Storybooks

Objective: To give students a chance to see and read fellow students' work and to have their own work read by others.

Materials: Paper and pencils

Stapler

Ditto masters

Typewriter (optional)

Procedure: After studying the learning experience "The Muskrat", have each student write a short story about a muskrat. The stories may be true or made up. After the students finish their stories, type them on a ditto (or have the students write them directly onto the ditto master) and make enough copies so that each student can have a copy of every other student's story. The students can make covers for their storybooks, then staple them together.

Optional: Ask each student to illustrate their stories on the empty spaces on the ditto master. Then, when the storybooks are complete, they will be coloring books as well.

Grades 2-3

Scrambled Eggs

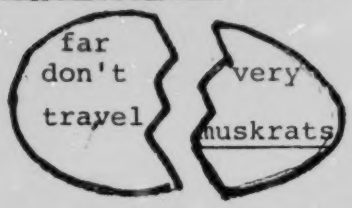
Objective: To practice arranging a complete sentence using correct capitalizaion and punctuation.

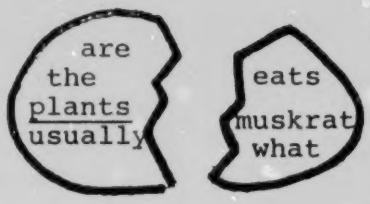
Materials: Copies of the handout on p. S-2

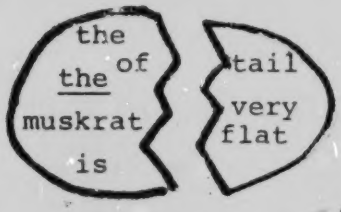
Pencils

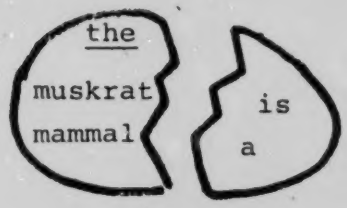
Procedure: Make copies of the handout on p. S-2 and give each student a copy. Tell the class that in each egg a sentence has been scrambled. The underlined word comes first when the sentence is arranged in the proper order. The student is to unscramble the words and write a complete sentence on the lines under each egg. Remind them to capitalize the first letter at the beginning of each sentence and put a period at the end. Without a capital letter and a period their sentences are incomplete.

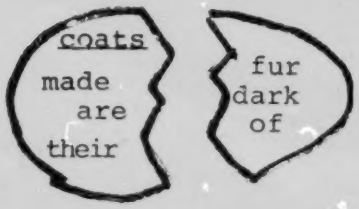
SCRAMBLED EGGS

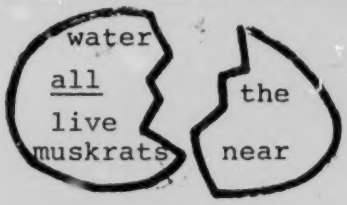


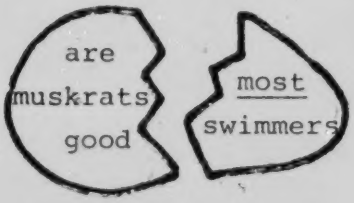


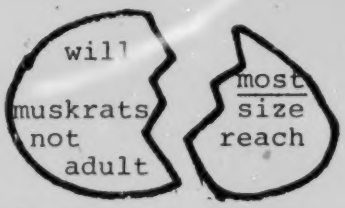


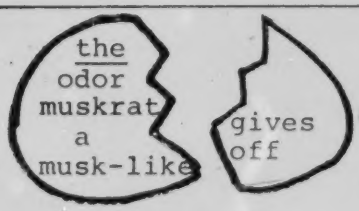


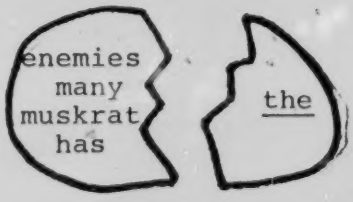












#108 THE MUSKRAT (cont.)

Grades 2-3

Person, Place or Thing--Grammar

Objective: To help the child understand the different forms of a noun.

Materials: Paper and pencil

Procedure: Write the words given below on the board and explain to the class that each word is the name of a person, place, or thing. Ask each student to write the words on a piece of paper and after each word write "person" if the word is the name of a person, "place" if it is the name of a place, and "thing" if it is the name of a thing. This exercise can be done either as a class or individually if the children are capable.

1. marsh (place)
2. park (place)
3. trapper (person)
4. muskrat (thing)
5. plants (thing)
6. student (person)
7. fur (thing)
8. lodge (place)
9. nails (thing)
10. ranger (person)
11. pencil (thing)
12. teacher (person)

#108 THE MUSKRAT (cont.)

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#108 THE MUSKRAT (cont.)

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THE NOT-SO-COMMON OYSTER

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310 Willard Hall Education Building

University of Delaware

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TITLE: THE NOT-SO-COMMON OYSTER

* Concept: I.B.4.a.(3)

I. The earth is a finite natural system.

B. All living things have arisen from and are dependent upon the natural system of the earth.

4. The interaction of organisms with their environment leads to great diversity and wide distribution of organisms.

a. Natural selection leads to evolution.

(3) NATURAL SELECTION RESULTS FROM THE INTERACTION OF INDIVIDUAL VARIATIONS WITH ENVIRONMENT.

** Marine Concept: 3.21

3. Marine organisms interact in complex ecosystems.

3.2 Marine organisms are adapted to their environments in different ways.

3.21 MARINE ORGANISMS ARE ADAPTED DEVELOPMENTALLY, STRUCTURALLY, FUNCTIONALLY, AND BEHAVIORALLY TO THEIR WAYS OF LIFE.

Grade Level: 3-5

Subject: Science

Periods: 4-Various

Author: Guerke

R576

* From A Conceptual Scheme for Population-Environment Studies, 1973. Cost $2.50.

** From Marine Environment Proposed Conceptual Scheme, 1973. No charge.

Both conceptual schemes are available from Robert W. Stegner, Population-Environment Curriculum Study, 310 Willard Hall, University of Delaware, Newark, DE 19711.

NOTE TO TEACHER: For instructions on using this learning experience, teacher background material, and supplementary or alternative activity suggestions, see the Teacher Packet, pp. 17-35.

STUDENT PACKET

Independent Study

INTRODUCTION

People all around the world enjoy eating many kinds of food from the sea. Seafood is usually cheap for people who live near the ocean because they can catch their own crabs, clams, fish, and oysters. This story is about the oyster, an animal which lives in a shell. Since the oyster does not move from place to place after it grows up, it has become one of the few marine animals to be farmed and harvested. Oystermen grow and collect these animals to sell for people to eat.

As you read the story you should be looking for the answers to these questions:

What does an oyster look like?

What is the oyster's home?

What does an oyster eat?

How do oysters begin life and how do they grow?

Although remembering these facts will help you in doing the exercises, you may turn back to the story if you need help. Directions for the packet are below, and each exercise has its own instructions at the top. Enjoy the story!

DIRECTIONS

1. You should complete this lesson. This means:
   a. Take the pretest. (p. 4)
   b. Read the story. (pp. 6-8)
   c. Do the "Using New Words" activity. (p. 9)
   d. Do both "How Well Did You Read?" activities. (pp. 10-11)
   e. Do both "Vocabulary" activities. (pp. 12-13)
   f. Take the post-test. (p. 14)
   g. Choose and complete a creative activity. (p. 15)

   You will check your own work with the answer page (p. 16). Be sure to mark the number you have correct at the bottom of each exercise. You may do this lesson at your own speed. It does not have to be completed at one sitting. It will probably take you about four 30-minute reading periods.

2. You should be able to tell the difference between facts and fiction as you read the story. You should be able to answer questions about the facts.

3. You should be able to remember what happened in the story. You will do an exercise putting events in the oyster's life in the correct order.

4. You will be given facts from the story. You should be able to answer questions from this information.

5. You should be able to use the information you have learned in this story later for a math, a spelling, or a science lesson.

6. When you complete all of the written activities in the packet, you will choose a creative activity to do on your own. You will also look for library books and read about other foods from the sea. You can share what you learn from these books with the class.

PRETEST

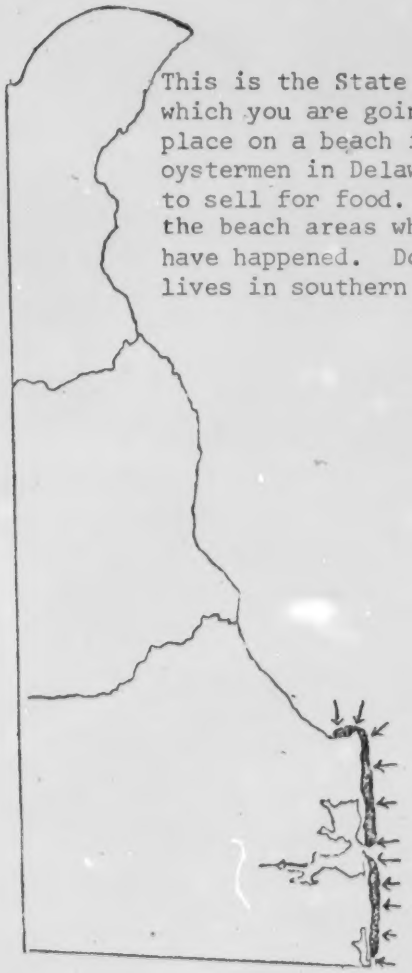
Directions: Match these words and their meanings. Put the number of the meaning in front of the word.

_____ shell	1. a kind of sea animal which people can eat.
_____ marine	2. to release eggs and sperm.
_____ adult	3. not a friend.
_____ spawn	4. people who grow food.
_____ spat	5. clusters of oysters.
_____ million	6. not rough.
_____ hands	7. a very hard covering.
_____ enemy	8. 1,000,000
_____ gills	9. a grown-up.
_____ oyster	10. young oyster newly attached to a clean surface.
_____ oyster farming	11. of the ocean.
	12. organs used to get oxygen.
	13. oyster production under controlled conditions.

Number correct _____

This is the United States.

The arrow points to the state of Delaware.



This is the State of Delaware. The story which you are going to read could take place on a beach in Delaware. There are oystermen in Delaware who harvest oysters to sell for food. The small arrows mark the beach areas where this story could have happened. Do you know anyone who lives in southern Delaware?

THE NOT-SO-COMMON OYSTER

It was very early in the morning and the sun was not yet up. There was a warm glow cast all around. The only sound I could hear was the small waves lapping onto the shore. The sand felt damp between my bare toes as my father and I walked along the beach. We walked close to the water's edge, looking for things that the ocean had washed onto the beach. We found stones, smooth glass, bits of driftwood and shells.

I bent over to pick up a big shell, a kind I had seen before. It was much smoother on the inside than on the outside, and was not a pretty shell. "Do you know what kind of shell this is?" I asked my father. My father is a marine biologist. He studies plants and animals that live in the ocean and sometimes does experiments with them.

"That," he said, "is an oyster shell. You can find many of them near the Atlantic Ocean. What do YOU know about oysters?"

"Well," I said slowly, because I am not a marine biologist, "sometimes Mother orders them for dinner when we eat in a restaurant. Do little fish live in that shell?"

"Oysters are mollusks, not fish," my father said. "That shell you found is one-half of an oyster's home. The oyster is a bivalve mollusk, which means that he lives between two shells held together by a strong muscle and a hinge. The upper shell is usually flat. The lower shell is rounded or cupped. Did you find a top or a bottom shell?"

"I think this is a bottom shell," I said. "One end of the shell is round. It is not flat."

"I would also guess it's a bottom shell," my father said. "The oyster has a soft body with a heart and stomach and that shell protects the oyster from most of its enemies. But starfish are able to open the shell and eat the oyster inside. Some sea animals can even drill into the shell.

"When oysters are hatched, they do not have a shell and do not look like the adults. The shell you found belonged to an adult oyster. The adult oysters are found in shallow water and are sitters, which means that they are attached to a solid object. Sometimes you can find them during low tide. When conditions are good, oysters can form reefs, just like coral animals do.

"In the months of June, July, and August, the temperature of the water where oysters live is between 65 and 90 degrees. During this time, the adult oysters spawn. The female oyster releases her egg cells into the water, releasing between 14 million and 140 million eggs at a time! Then the male oyster releases sperm cells into the water. A sperm cell unites with an egg; this is called fertilization and takes place in the water. Most oysters do not become adults; most die before reaching this age. Within a few hours, the fertilized eggs develop into larvae. The larvae are very tiny, have no shell, and do not look anything like the parent oysters. They swim about or are carried by the water currents for ten days to two weeks. What do you think happens then?"

"Well," I said slowly, "I guess they have to find homes. Is that what really happens?"

"You're right. Each larva is beginning to look for a home. It has developed a strong foot which it uses to attach itself to a firm, clean surface. It is now that an oyster begins to form its shell.

"Laboratory tests show that these young oysters choose where they will settle. A place that often seems to be just right is another oyster's shell. A newly attached oyster is called a spat. It is important to remember that not all the fertilized eggs develop into larvae. Not all the larvae become spat. And not all spat will become adult oysters.

"An oyster eats, too. What do you think an oyster eats?"

"I don't know," I said. "I guess it must eat something small. It must get food that is in the water."

"Right again," my father said. "An oyster does get food from the sea water. In the sea are millions of microscopic plants and animals. These tiny plants and animals are food for the oyster. An oyster's gills have tiny, moving hairs on them. These hairs help to draw in sea water between the two shells and also help to carry

food to the mouth. When the oyster pumps in water between the two shells, food moves in also. Remember that the oyster is attached and cannot move to catch its food. If there are many plants and animals in the sea water, it does not have to pump hard for its food. If there are few plants and animals in the water, the oyster has to pump faster for food. Sometimes the oyster will close tightly and stop pumping. Why do you think it does that?"

"I'm not the marine biologist. Maybe it stops pumping when it doesn't want anymore. Why does it stop pumping water?" I asked my father.

"The oyster will stop pumping water if the temperature of the water becomes too cold. It will also stop pumping if it is left on dry land when the tide changes. The oyster breathes with its gills by removing the oxygen contained in the water. Thus, when the oyster is closed tightly, it will still be able to get the oxygen it needs from the water trapped inside its shell. This shell helps the oyster in other ways. Can you think of any?"

"You said it protected the soft oyster from enemies," I remembered.

"Good. The oyster cannot protect itself if its shell is broken open. But the shell is very hard and gives the oyster a lot of protection. Some of the oyster's enemies, such as oyster drills, starfish, blue crabs, stone crabs, and black drum fish, can attack from the outside. Other enemies can live inside the shell. For example, one type of microscopic enemy called a parasite has killed millions of oysters. Oyster crabs and oyster wafers also live inside the shell and may or may not harm the oyster. Oysters also have a hard time finding a clean place to attach themselves. They often cement themselves together into groups or hands. Clams, mussels, and other sea animals also need to be attached to clean places and compete with the oysters for space. Oysters have a hard time growing up. They are often hard to find. This makes them quite expensive. Do you know what scientists are doing about this problem?"

"I guess they are trying to help the oyster grow up. The marine biologists probably try to protect the oyster from its enemies," I said.

"Yes," my father said, "oysters are an important food from the sea. The earth is getting very crowded and people need to get more of their food from the sea. Scientists have been working with oystermen to try to keep more oysters alive. Oystermen can help oysters to grow quickly by protecting the spat and providing clean places on which the young oysters can attach themselves. In about three years, the oysters are ready to be sold. Often an oysterman will experiment because he wants to have more oysters to sell. Oyster farming is not new. Oysters have been farmed in Japan for a long time."

"The oyster is an important sea animal, isn't it, Dad?" I asked. "This shell looks ugly, but it was once a home."

"Yes, we need to find new ways of getting food from the sea. The oyster is one of the sea animals that can be farmed. I am certain scientists will help to find more ways to farm sea animals. Here is another oyster shell."

By this time, the sun was getting higher in the sky. I was hungry for breakfast. As we walked back, I thought about the not-so-common oyster that had once lived in this shell."

USING NEW WORDS

oysters	spat	marine biologist
bivalve mollusk	microscope	spawn
larvae	enemy	
attach	shell	

DIRECTIONS: Say each word to yourself. Read each sentence and find the word in the list that belongs in the sentence. Write the word on the line. Read the sentence again. Did you choose the correct word?

1. A _____ is an animal that has two shells that fit together.
2. The _____ are very young oysters that do not look at all like their parents and are not yet attached.
3. The young oyster which has just attached itself to a clean surface is called a _____.
4. The starfish is the oyster's _____.
5. The _____ is the only protection an oyster has from its enemies.
6. A person who studies life in the ocean is a _____ _____.
7. Mother had _____ for dinner.
8. In June, July or August when the water is warm the adult oysters will _____.
9. The oyster larva must _____ itself to a firm, clean surface.
10. To see something very small we can use a _____.

Be sure to check your answers with the answer page after you have finished!

Number correct _____

HOW WELL DID YOU READ?

DIRECTIONS: This exercise will check to see if you can tell whether a statement is true or false. Write true next to a sentence if it is correct. Write false next to a sentence if it is not a true statement.

1. _____ Oysters are able to sting people with their sharp tails.

2. _____ The oyster's body is protected by a shell.

3. _____ The oyster pumps food into his mouth along with the sea water.

4. _____ Farmers plant oyster seeds in their gardens.

5. _____ Oyster eggs are fertilized outside the female's body.

6. _____ The oyster larvae swim about or are carried by water currents for ten days to two weeks.

7. _____ Oysters can be eaten by people.

8. _____ Oysters are cuddly and cute.

9. _____ Starfish are one of the oysters' worst enemies.

10. _____ The rocks that oysters attach themselves to are called spat.

Number correct _____

HOW WELL DID YOU READ?

DIRECTIONS: Arrange the following sentences about the oyster's life cycle in the order in which the events occur, beginning with the adult oysters' spawning.

a. Adult oysters spawn in June, July, August.

b. The young oysters develop shells.

c. The egg cells are fertilized by sperm cells.

d. The larvae attach themselves to a firm, clean surface.

e. The larvae swim about or are carried by water currents for ten days to two weeks.

f. The fertilized eggs develop into larvae which do not look anything like the parent oysters.

1. __a__

2. _____

3. _____

4. _____

5. _____

6. _____

Be sure to check your answers.

Number correct _____

VOCABULARY ACTIVITY

DIRECTIONS: Write the letters ft in the blanks to make words. Then find the right word for each sentence and write it on the line.

le___	swi__ly	dri__ing
gi___	so___	li__ed

1. The wood was _____ on the water.
2. My father _____ answered my question about oysters.
3. I _____ the shell so that I could see it better.
4. The body of the oyster is _____.
5. The oyster shell was _____ on the shore when the tide went out.
6. Using several shells I can make a _____ for my mother.

Be sure to check your answers.

Number correct _____

VOCABULARY ACTIVITY

DIRECTIONS: Here are some new words. Divide each word into syllables. Write the syllables on the line. Say the word to yourself. In some cases the syllables are clues to the meanings of the new words.

1. oyster _____ a sea animal living inside two shells; a kind of seafood for people.
2. marine _____ of the ocean.
3. bivalve _____ having two shells.
4. mollusk _____ a large group of animals most of which have a shell.
5. starfish _____ a sea animal with a star shape; it is not a fish.
6. adult _____ grown-up.
7. farmer _____ person who grows food.
8. release _____ to let loose.
9. microscope _____ instrument which makes very tiny things look large enough to be seen.
10. attach _____ to fasten on.

Now check your work with the dictionary to see how many you got right.

Number correct _____

POST-TEST

Directions: Match these words and their meanings. Put the number of the meaning in front of the word.

_____ shell	1.	a bivalve; food from the sea
_____ marine	2.	to release eggs and sperm
_____ adult	3.	something that harms or injures
_____ spawn	4.	people who grow food
_____ spat	5.	clusters of oysters
_____ attach	6.	not rough
_____ hands	7.	a very hard covering
_____ enemy	8.	to fasten on
_____ gills	9.	a grown-up
_____ oyster	10.	young oyster newly attached to a hard surface
_____ oyster farming	11.	of the ocean
	12.	organs used in getting oxygen
	13.	oyster production under controlled conditions.

Number correct _____

If you get nine correct answers you may select another activity.

SELECT A CREATIVE ACTIVITY

1. Read about other animals of the ocean such as fish, shrimp, crabs and clams, that are food for people. Make a folder about these animals. Draw pictures of them too.

2. Draw a picture of your favorite part of the story.

3. Pretend that the story is a book. Draw a cover for this book.

4. Using sea shells, glue, and felt-tip markers make a pretty gift for your mother.

Some Books You Might Like To Read

Goudey, Alice E. 1959. Houses From the Sea. Charles Scribner's Sons, New York.

Huntington, Harriet E. 1941. Let's Go to the Seashore. Doubleday and Company, Inc., Garden City, New York.

Kohn, Bernice. 1970. The Beachcomber's Book. The Viking Press, New York.

ANSWER PAGE

PRETEST Page 4

7 shell
11 marine
9 adult
2 spawn
10 spat
8 million
5 hands
3 enemy
12 gills
1 oyster
13 oyster farming

USING NEW WORDS Page 9

1. bivalve mollusk
2. larvae
3. spat
4. enemy
5. shell
6. marine biologist
7. oysters
8. spawn
9. attach
10. microscope

HOW WELL DID YOU READ? Page 10

1. False
2. True
3. True
4. False
5. True
6. True
7. True
8. False
9. True
10. False

HOW WELL DID YOU READ? Page 11

1. a
2. c
3. f
4. e
5. d
6. b

VOCABULARY ACTIVITY Page 12

left swiftly drifting
gift soft lifted

1. drifting
2. swiftly
3. lifted
4. soft
5. left
6. gift

VOCABULARY ACTIVITY Page 13

1. oys ter
2. ma rine
3. bi valve
4. mol lusk
5. star fish
6. a dult
7. farm er
8. re lease
9. mi cro scope
10. at tach

POST-TEST Page 14

7 shell 5 hands
11 marine 3 enemy
9 adult 12 gills
2 spawn 1 oyster
10 spat 13 oyster farming
8 attach

TEACHER PACKET

INTRODUCTION

This auto-instructional reading activity is designed for students in grades three through five. The student section of the activity provides the child with his own set of materials, including a set of instructions, standards to measure his own competence, and an answer sheet with which to check his answers. It should take him approximately four 30-minute reading periods to fulfill this activity's requirements. However, he is instructed to proceed at his own speed.

The teacher's section of this unit is designed to aid the student in correlating the subsequent activities. These include suggestions for complementary classes in reading and vocabulary development, spelling, math, language arts, and art. These lessons are structured to develop the student's and teacher's interest in marine environment education in disciplines other than the traditional science context.

STUDENT LEARNING OBJECTIVES

1. To show a comprehension of the oyster's life cycle by completing reading and vocabulary activities. These activities will be based upon facts from the story.
2. To demonstrate in writing the ability to draw conclusions based upon the facts in the story. To be able to discriminate between fact and fiction in these exercises.
3. To demonstrate the ability to react personally to the events in the story by participating in class activities. To show a willingness to share in a creative activity.
4. To demonstrate an awareness of the everyday experiences which are related to science by completing three exercises involving other disciplines.
5. To attain 90% or better on self-administered tests.
6. To contribute to a class discussion comparing and contrasting food harvested from the sea with food harvested from the land. This comparison should be in terms of availability, farming techniques, and yield.

BACKGROUND FOR THE TEACHER

The Crassostrea virginica, or Eastern Oyster, is found in shallow North American waters from Cape Cod to Florida. The oyster is a bivalve mollusk. The animal itself has a soft body enclosed between two shells. The adult oyster is at least three inches long. At each spawning in the summer, the female releases about a hundred million tiny eggs. Fertilization of the eggs is external. The eggs develop into larvae, which swim about or are carried by the current for ten days to two weeks. When the organism is ready to form its shell, it attaches itself with a strong muscular foot to a firm, clean surface. The larvae, as seen in laboratory tests, seem to have a preference for attaching to oyster shells. Of course, many oyster larvae never become spat, the name by which the newly-set young oysters are known. The mortality rate is quite high due to predation. Subsequent to this stage, the oyster develops into adulthood in about three years. Since it is immobile, the oyster must obtain all its nourishment from the plankton carried in the water which passes through its gills. The oyster falls prey to both internal and external enemies. Oyster crabs and oyster wafers (not usually harmful), boring sponges, and protozoan parasites often reside inside an oyster's shell. Starfish, oyster drills, blue crabs, stone crabs, black drum fish, skates, and whelks are able to externally attack the

shell and feed upon the soft body within. Also comb jellies eat oyster larvae. It is no wonder then that the common oyster frequently becomes not-so-common.

Oystermen, in a sense, are marine farmers who attempt to increase the yield of their crop by distributing clean cultch (shells for larval attachment) and by seeding protected sites in order that more people may share in the abundance of the sea.

STORY SUMMARY

"The Not-So-Common Oyster" is a story which combines factual information with imagination. As a child is walking along the beach with her father, she picks up an oyster shell. In answer to the child's questions, the father explains the use of oysters as a human food source and describes their life cycle. The purpose of the story is twofold: 1) to discover the structural and functional capabilities of the oyster within its marine environment and 2) to emphasize that the marine environment is a source of food which may be harvested by man.

TEACHER PREPARATION

1. Obtain the super-8 film loop "Mollusks" (or a suitable substitute).
2. Duplicate Student Packets.
3. From the masters included (pp. 31-32) make transparencies of the oyster anatomy.
4. If desired, make "New Words" transparencies (pp. 33-34).
5. Duplicate the exercises to be used from the Teacher Packet.

PROCEDURAL PLAN

The suggestions below are for use of the story with a group reading class instead of as an auto-instructional unit or as a supplement to the auto-instruction. The teacher should note that additional comprehension and vocabulary activities, with answer keys, are included for this purpose. These exercises should be duplicated for the students. This group activity can include either the entire class or a limited number of students who need extra help and attention.

1. Show the super-8 film loop "Mollusks." The students will see the diversity of this phylum of animals with shells. Discuss those which may be used for food by man. Suggest that man is dependent upon the marine environment for some of his food. It may be mentioned that man can harvest some marine organisms.

2. Show the transparency illustrating the anatomy of the oyster. Explain that the story is about one particular food from the sea, the oyster. Ask the children what experiences they have had with oysters. Have they ever eaten oysters? Where would they find an oyster's shell? Tell them that in this story they will discover many unusual facts about oysters.

3. If desirable, use the two transparencies entitled "New Words." Have the students read as many words as they can without help. Encourage them to use what they know to analyze the meaning of the words that are new to them. The teacher may pronounce the word and have the students repeat it. These transparencies may also be used in vowel and consonant exercises for review. For example: "Who can find a word that begins with the same letter as boy?" The student should select either biologist or bivalve. These exercises could also be used with other sounds and blends.

4. Next, have the students look at the maps at the beginning of the story (p. 5). Since oysters live in the water, have the students guess the areas where oysters possibly live. Have them explain why they chose those particular locations.

PURPOSE IN READING THE STORY

Write the following list of questions on the chalkboard for the students to think about as they read the selection. Have the students read the story independently to find answers to the questions.

1. What does an oyster look like?
2. What is an oyster's home?
3. What does an oyster eat?
4. Who are the oyster's enemies?
5. What happens when the oyster meets his enemies?
6. Why are oysters important to people?
7. How do oystermen care for oysters?

CLASS DISCUSSION

Follow the independent reading with a discussion of the answers to the questions as a means of checking the students' reading comprehension. If there is disagreement about any answer, have the student find and read the sentence which verifies his answer. To check for vocabulary comprehension, have different students find and read the definitions of the new words.

Help the students realize that although the story about the oyster is told in a fictional manner, it contains factual information. Have several students select a fact and read it to the group. Then have several students read a fictional sentence. Ask the students how the facts differ from the fictional statements. Have them discover that the facts are true, accurate statements.

Ask the students how this information about the oyster may have been collected and by whom. Some children may already know that it is the work of a marine biologist to study life in the ocean and pass on his information to other people. Encourage the children to learn more about the sea and the men who study it.

LANGUAGE ARTS ACTIVITIES

Show the film loop "Mollusks" again slowly. Make no comment except to say that you want the children to look carefully. When the film is finished, ask the students to write their own story about any one of the marine animals that they have just seen and in it, pretend that they are that animal. Encourage them to be imaginative. They should write at least six sentences; more, if they choose. You should write on the chalkboard any word that a student has difficulty spelling. The students may illustrate their work when it is completed. Share these stories with the group by asking for volunteers to read their own stories.

MATH ACTIVITIES

If the students know the basic skills required for the given math exercise (p. 24), use this activity. If not, use an aquarium to have the students count various sets of organisms for addition and subtraction activities. The teacher can also invent problems based on the marine environment appropriate for the skill level of the group.

SPELLING ACTIVITIES

Select ten or more of the words from the "New words" list. Have the children use these as the spelling words for the week. Discuss these words in terms of word-building skills that the group has already mastered. In a discussion, have the children use the words in context. Provide the children with a vocabulary exercise appropriate for the selected words. (There are several contained within this activity.) Have the children correct their own work to see their mistakes. Give

the group a pre-test on the spelling words. Those students who score ninety percent or higher do not need to continue with the remainder of the activity. Encourage those who must take the spelling test again to study their word lists. Dictate the entire list of words to those who are taking the retest. The difficulty of the words on the list should be based on the capabilities of the group. Next, have the students do the crossword puzzle to strengthen spelling and word usage skills. The whole group may do this puzzle.

ART ACTIVITIES

Many of the creative activities suggested in the Student Packet may be used for art activities. Other activities include creating various designs based on the shapes of fish and seashells. The student should be encouraged to be imaginative with colors and to fill the entire page so that the designs may be used to decorate the classroom.

READING CARD GAMES

Prepare a "deck of cards" using the instructions on p. 35.

1. Oysters and Starfish Word Game: This game requires two players. One player will hold the cards for the other to read. The reader will read each word until he comes to a picture. If he comes to a picture of an oyster, he may continue. If he comes to a picture of a starfish, he must stop reading. It is now his turn to hold the cards for the other player to read.

2. Search Game: The picture cards are removed from the deck of cards. This game may be played with the teacher and one or more players. Each player needs his own set of cards. The teacher will say, "Who can find the word biology? Who can find a word that begins with the same letter as dog? Who can find a word that ends with the same letter as left?" and so on. The teacher may keep score by giving points to the student who first finds the card which answers the questions.

3. Two by Two Game: This game is played with two people. Remove the picture cards from the deck. Shuffle the cards. Each player is dealt two cards. The players must set a standard for matching the cards, e.g., the same initial sound, the same final sound or, having two syllables. Now the players read the words on the cards that they have been given. One at a time, they may exchange one card for a random card in the shuffled deck. Each time a player has matched two cards he receives a point and those two cards are removed from the game. The first player to get ten points wins the game. Begin a new game by shuffling the cards again and setting a new standard for matching.

GROUP WRITTEN ACTIVITIES

Reading

A. Study Skill Activity

DIRECTIONS: Put X in the Where column if a word or phrase tells where something happened. Put X in the When column if the phrase tells when something happened.

	Where	When
1. in the ocean		
2. inside the shell		
3. then		
4. in a few weeks		
5. under		
6. tomorrow		
7. on top of		
8. today		
9. at the beach		
10. once		
11. there		

B. How Well Did You Read?

DIRECTIONS: Read the first part of each sentence. Then read all the endings. Draw a line under every ending that could be the right answer.

1. The oyster shell in this story was found on the shore because

   the tide washed it up.
   the oyster was no longer alive.
   the oyster put it there.

2. The oyster gets its food from the water because

   its stomach is outside the shell.
   it lives in the sea.
   tiny plants and animals are carried into the shell with the water.

3. Farmers grow oysters because

   oysters can be sold for food.
   they think it is easy work.
   they usually can harvest oysters.

4. The adult oyster is attached to a hard surface because

   it cannot swim.
   it does not like the soft, oozy bottom.
   it is sitting on eggs.

C. Who Am I?

DIRECTIONS: Read each riddle. Answer the question by writing the answer on the line.

1. I live in a shell.
   I have a soft body.
   I get my food from sea water.
   Who am I? _____

2. Oysters are food for me.
   I can open the oyster's shell.
   I live in the ocean.
   I have five arms.
   Who am I? _____

3. I grow oysters.
   I make a nice clean place on which the spats can attach.
   I harvest the oysters when they are grown.
   Who am I? _____

4. I am a young oyster.
   I will soon start to grow a hard shell.
   I have just attached myself to a clean place.
   Who am I? _____

5. I protect oysters from their enemies.
   I am not pretty but I am very hard.
   One of my sides is rounded; the other is flat.
   Who am I? _____

D. What Do You Know About Oysters?

DIRECTIONS: Some of these sentences are true. Mark them T. Some are false. Mark them F.

1. ___ Oysters seem to like the color red.
2. ___ Oysters eat tiny marine plants and animals.
3. ___ Oysters are attached to a clean smooth surface.
4. ___ The mother oyster sits on her eggs.
5. ___ Oyster eggs are about the same size as walnuts.
6. ___ Some people use science to help them grow oysters.
7. ___ The oyster's body is between two shells.
8. ___ Male oysters are very colorful.
9. ___ Starfish protect oysters from their enemies.
10. ___ Oysters live in shallow water.

LANGUAGE ARTS ACTIVITIES

A. Singular Possessives

DIRECTIONS: Read each sentence. Think of another way to say the part that is underlined. Write the sentence another way on the line.

1. The shell of the oyster is very hard.

_____

2. The body of the oyster can be food for man.

_____

3. The foot of the oyster holds it to a rock.

_____

4. The water of the ocean provides food for the oyster.

_____

5. The larvae of the oyster are very numerous.

_____

6. The home of the oyster is its shell.

_____

B. Vocabulary

DIRECTIONS: Here are some words you know. The letters in each word are scrambled. Turn the letters around to make a word. Write the word on the line. Then write a sentence on the line to show that you know what each word means. (Here is a clue: Each word ends with the letters "er".)

1. ewrat _____
_____

2. yesotr _____
_____

3. mrafre _____
_____

4. sfatre _____
_____

5. obletsr _____
_____

MATH ACTIVITY

DIRECTIONS: Read each of these problems. Write an equation. Solve the equation.

1. Father bought sixty oysters. Mother cooked twenty-seven oysters for dinner. She put the rest of the oysters in the freezer. How many oysters did Mother freeze? _____

2. There were fifty-nine spats attached to a rock. The next day forty-seven more spats attached themselves to this rock. How many spats in all were on this rock? _____

3. John picked up ninety-eight shells on the beach. He kept nineteen of these to add to his collection. How many shells did he not use?

_____

4. Jane made six shell sculptures. In each one she used seven shells. How many shells did she use for the whole project? _____

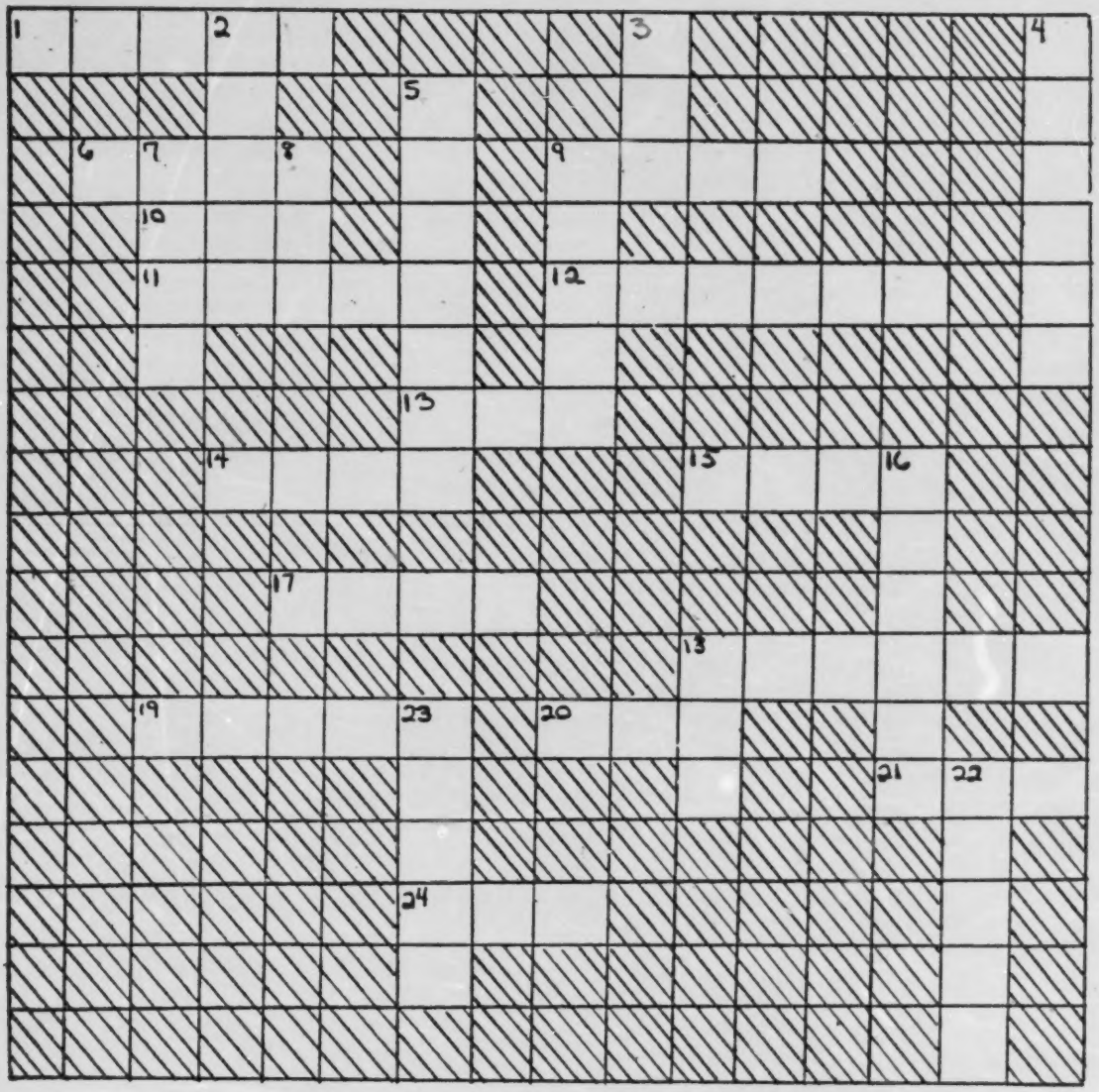
5. A farmer had four hundred thirty-two baskets of oysters to sell. He sold two hundred ninety-seven of these to a canning factory. How many baskets of oysters did he have left? _____

6. Eight people ate dinner at our house last night. Three of these people had six oysters each. Five of them had five oysters each. How many oysters were eaten at our house last night? _____

7. In one part of the sea there lived eight starfish, nine oysters, six clams, seven fish and eleven crabs. How many animals lived in this part of the sea? _____

8. Seven people ate fifty-six oysters. If each person ate the same amount of oysters, how many oysters did each person eat? _____

C. Oyster Crossword Puzzle



The numbers in parentheses tell you how many letters there are in the words.

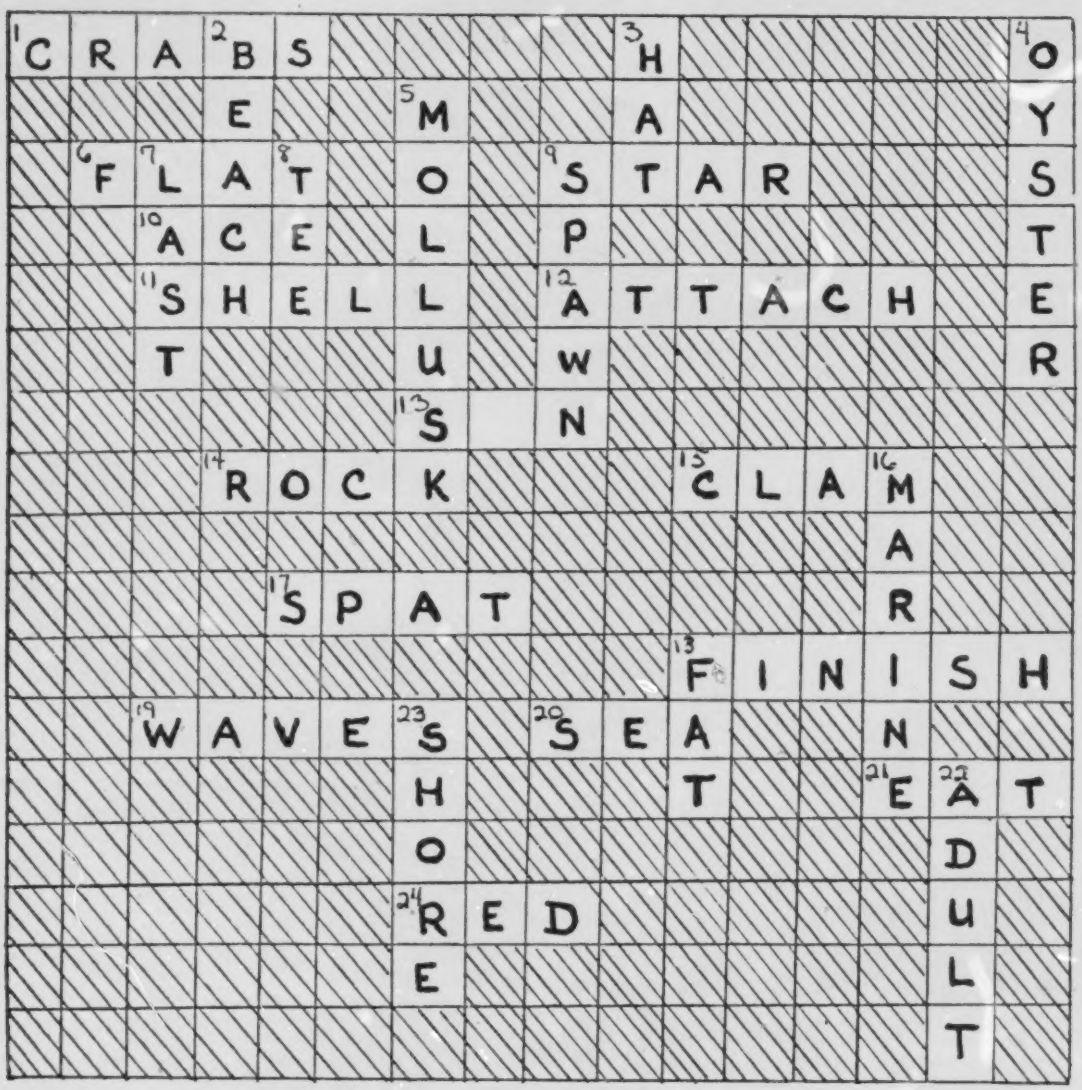
ACROSS

1. a seafood with claws (5)
6. We have to fix a ____ tire.(4)
9. One oyster enemy has five arms and is shaped like a ____.(4)
10. highest card in a deck (3)
11. I found an oyster _____.(5)
12. to fasten on to (6)
13. We get energy from the ____.(3)
14. An oyster might attach to a _____. (4)
15. another seafood with two shells (4)
17. a young oyster that has just attached (4)
18. to end (6)
19. The _____ wash shells onto the beach.(5)
20. another word for ocean (3)
21. We ___ lunch at noon.(3)
24. the color of Santa's suit (3)

DOWN

2. We like to go to the _____.(5)
3. what you wear on your head (3)
4. a bivalve mollusk (6)
5. most of the animals in this group have a shell (7)
7. the final one (4)
8. to begin a golf game, the ball is hit first from a ___.(3)
9. to release sperm and egg cells (5)
16. of the ocean (6)
18. the opposite of thin (3)
22. grown-up (5)
23. the edge of the ocean (5)

C. Oyster Crossword Puzzle


1 C R A 2 B S 3 H 4 O
E 5 M A Y
6 F 7 L A 8 T O 9 S T A R S
10 A C E L P T
11 S H E L L 12 A T T A C H E
T U W R
13 S N
14 R O C K 15 C L A 16 M
A
17 S P A T R
13 F I N I S H
19 W A V E 23 S 20 S E A N
H T 21 E 22 A T
O D
24 R E D U
E L
T

The numbers in parentheses tell you how many letters there are in the words.

ACROSS

1. a seafood with claws (5)
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18. the opposite of thin (3)
22. grown-up (5)
23. the edge of the ocean (5)

ANSWERS TO GROUP WRITTEN ACTIVITIES

READING

A. Study Skill Activity Page 21

	Where	When
1.	X	
2.	X	
3.		X
4.		X
5.	X	
6.		X
7.	X	
8.		X
9.	X	
10.		X
11.	X	

B. How Well Did You Read? Page 21

1. the tide washed it up.
   the oyster was no longer alive.

2. it lives in the sea.
   tiny plants and animals are carried into the shell with the water.

3. oysters can be sold for food.
   they usually can harvest oysters.

4. it cannot swim.
   it does not like the soft, oozy bottom.

C. Who Am I? Page 22

1. oyster
2. starfish
3. farmer or oysterman
4. spat
5. shell

D. What Do You Know About Oysters? Page 22

1.	F	6.	T
2.	T	7.	T
3.	T	8.	F
4.	F	9.	F
5.	F	10.	T

LANGUAGE ARTS ACTIVITIES

A. Singular Possessives Page 23

1. The oyster's shell is very hard.
2. The oyster's body can be food for man.
3. The oyster's foot holds it to a rock.
4. The ocean's water provides food for the oyster.
5. The oyster's larvae are very numerous.
6. The oyster's home is its shell.

B. Vocabulary Page 23

1.	water	(Sample sentence) The water was cold.
2.	oyster	Oyster stew is delicious for dinner.
3.	farmer	A farmer is always busy.
4.	faster	I can run faster than my sister.
5.	lobster	Would you like to have lobster for dinner?

MATH ACTIVITY Page 24

1.	33	5.	135
2.	106	6.	43
3.	79	7.	41
4.	42	8.	8

KEY TO OYSTER CROSSWORD PUZZLE Page 25

Across		Down	
1.	crabs	2.	beach
6.	flat	3.	hat
9.	star	4.	oyster
10.	ace	5.	mollusk
11.	shell	7.	last
12.	attach	8.	tee
13.	sun	9.	spawn
14.	rock	16.	marine
15.	clam	18.	fat
17.	spat	22.	adult
18.	finish		
19.	waves		
20.	sea		
21.	eat		
23.	red		

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Yonge, Charles M. 1960. Oysters. Wm. Collins' Sons & Company, New York.

Zachary, Hugh. 1969. The Beachcomber's Handbook of Seafood Cookery. John F. Blair, Winston-Salem, North Carolina.

SUGGESTED VISUAL RESOURCES

Super-8 Film Loops

International Communication Films, 1371 Reynolds Avenue, Santa Ana, California 92705. Mollusks

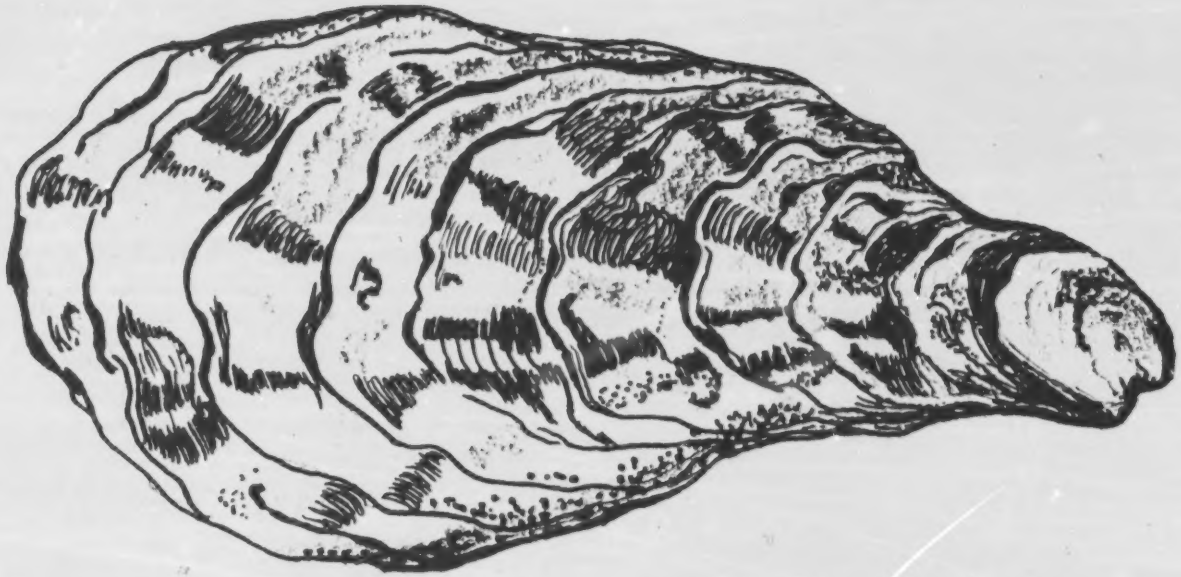
Thorne Films, 1229 University Avenue, Boulder, Colorado 80302
Horse Clam
Mussel

16 mm. Films

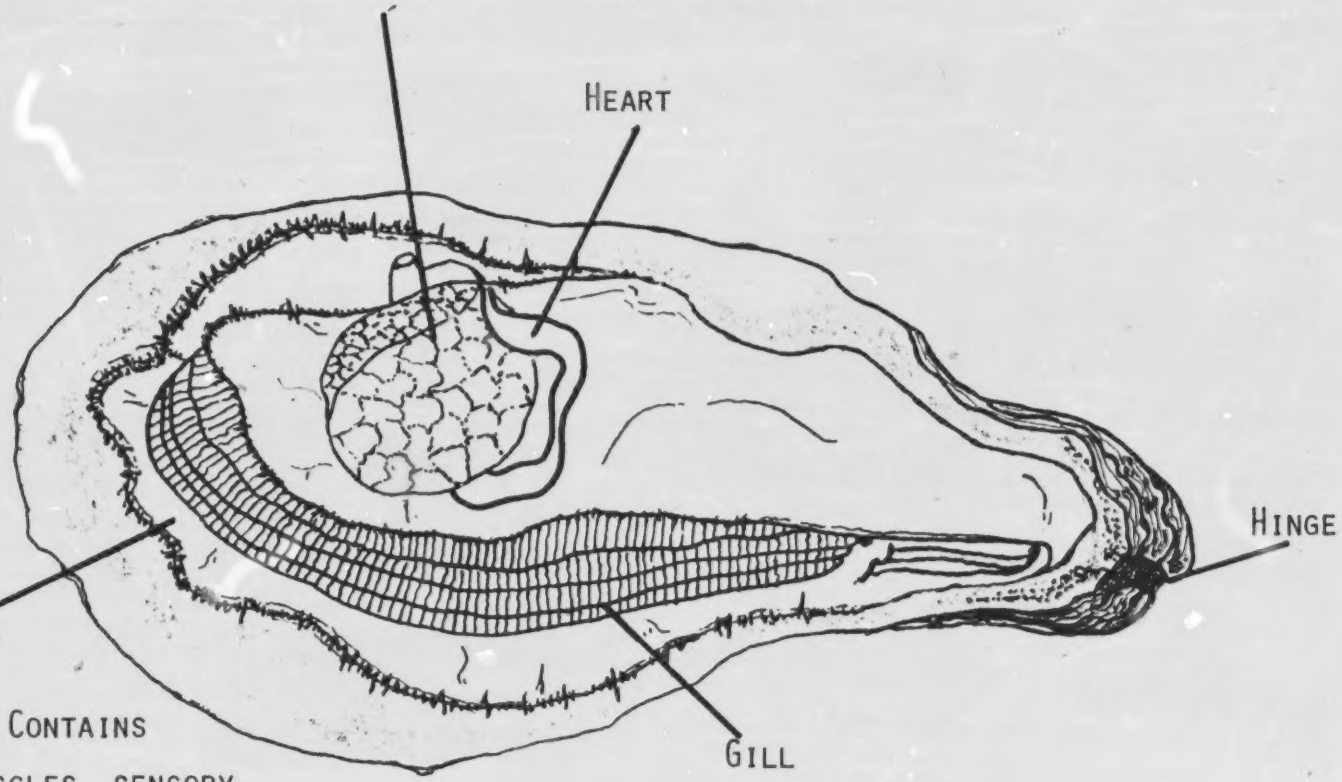
Encyclopedia Britannica Educational Corporation, Chicago, Illinois 60611
Life Story of the Oyster
Mollusks

Film Strip

Encyclopedia Britannica Educational Corporation, Chicago, Illinois 60611
Animals Without Backbones - the Snail and Its Relatives



LOWER OUTER SHELL OF AN OYSTER


ADDUCTOR MUSCLE (KEEPS THE SHELL CLOSED.)
HEART
HINGE
MANTLE
(BODY TISSUE. CONTAINS 3 LAYERS: MUSCLES, SENSORY ORGANS, AND A LAYER WHICH SECRETES SHELL-FORMING MATERIAL.)
GILL

ANATOMY OF AN OYSTER

I.B.4.a.(3)
(Mar. 3.21)
p. 32

NEW WORDS

oyster

spat

bivalve

mollusk

larvae

shell

spawn

collect

polluted

attach

microscope

NEW WORDS

starfish beach
restaurant
Atlantic Ocean
Delaware
experiment
driftwood
environment

PREPARATION FOR READING WORD CARD GAMES

Place each word below on a file card (3 x 5 or 4 x 6 inches)

adult
Atlantic
attach
August
beach
biologist
bivalve
bottom
break
broken
cells
certain
clams
common
crabs
crowded
currents
degree
dinner
driftwood
drill
early
eaten
enemies
enemy
experiment
farmers
fertilized
filter
finish
fish
fishes
flat
found
gills
glow
guess
heart
higher
hungry
important
Japan
July
June
larvae
lower
marine
microscope
million
mollusk
muscle
mussels
ocean
open
oxygen
oyster
people
polluted
protects
release
restaurant
Rome
scientist
shallow
shells
shore
slapping
smooth
sometimes
spats
spawn
sponges
starfish
stomach
strong
structures
studies
surface
temperature
tight
ugly
upper
waves
worms
young

FOR THE GAME "OYSTERS AND STARFISH"

Prepare 5 file cards with a picture of an oyster and 5 with a picture of a starfish. Make a copy of the directions for play given below to accompany the game.

DIRECTIONS FOR "OYSTERS AND STARFISH"

This is a word game. Only two people may play. One person will show the cards. The other person will read the words. When the reader comes to a card with an oyster's picture on it, he may continue. If he comes to a card with a starfish's picture on it he must stop reading. He will now hold the cards. The other person will begin reading the words. He must stop when he comes to a picture of a starfish. Be sure to mix up all the cards when you have read them all.
HAVE FUN!

Language Arts Activities Supplement

#109 THE NOT-SO-COMMON OYSTER

Unit Overview: Independent student study lessons about the oyster. Contains reading exercises, vocabulary activities, a crossword puzzle, and transparency masters of the oyster's anatomy.

Grades 1-3

What Happened Next?--Creative Writing

Objective: To determine if the child is getting the main idea so he can give a logical ending or solution to a story.

Materials: Copies of the handout on the following page.

Pencils, paper, and crayons

Procedure: Make copies of the handout on the following page and distribute them to the students. Ask the children to write what they think might happen next and how the story will end.

The story may be read to younger children followed by the writing of an experience story rather than individual stories.

Grades 2-3

Memory

Objective: To test and improve the child's recall ability and powers of observation.

Materials: Tray

Small items collected during a trip to the beach (oyster shell, driftwood, clam shell, piece of seaweed, starfish, etc.)

Paper and pencils

Cloth cover

Procedure: Each child should have a piece of paper and a pencil. Display the tray with several of the small items on it. After each child has had a brief look at the contents, cover the tray. Ask the children to write down the names of as many things as they can remember seeing on the tray. The person with the most answers is the winner.

Variations: Briefly display a tray of items to each child, then remove one, two, or more items from the tray. Allow each child to view the tray again and try to determine which items are missing. Conversely, items may be added and children may be asked to identify the additional items.

Read the story below. Then write what you think will happen next and how you think this story will end.

OSCAR OYSTER

Oscar Oyster was about three years old and had lived a very quiet life. He liked his home in the water and was never in need of anything that the sea could not provide. But, one Saturday morning in May changed his whole life.

Oscar had been sleeping peacefully when all of a sudden, there was a loud knocking on the outside of his shell and a frightened voice said, "Open up, Oscar. Let me in. They're after me!".....

#109 THE NOT-SO-COMMON OYSTER (cont.)

Grades 2-3

Dictionary Work

Objective: To review alphabetical order, using a dictionary and guide words.

Materials: Copies of the handout on p. S-4
Dictionary for each student
Pencils

Procedure: This activity is to be done with students who have worked with the dictionary and guide words before. Make copies of the handout on p. S-4 and give each student a copy. Explain what is expected in each column and do the first word with the students as an example.

Grades 4-6

To Stretch Your Mind--Matching Activity

Objective: To make students aware of additional information about the oyster.

Materials: Copies of the handout on p. S-5.
Pencils

Procedure: Make copies of the handout on p. S-5 and give each student a copy. Explain that not all the words were used in the learning experience "The Not-So-Common Oyster" and that this is to see how much more they know about the oyster.

Key:

1. oyster	2.metamor-phosis	3. gills	4. cilia
5.predators	6. plankton	7.Louisiana and the Chesapeake Bay	

#109 THE NOT-SO-COMMON OYSTER (cont.)

Name_____

Word to look up	Page word is found on	Definition of word	Guide words on page	Put words in alphabetical order
crabs				1.
beach				2.
shell				3.
spat				4.
waves				5.
clam				6.
spawn				7.
attach				8.
oyster				9.
sea				10.
mollusk				11.
shore				12.

TO STRETCH YOUR MIND

Match definitions below with the correct word from the Word List and place the word in the correct box.

1. Immobile, bivalve mollusk
2. Process where larvae change into tiny mollusks
3. Organs of the oyster that play an important role
4. Numerous, small beating hairs
5. "Enemies" of the oyster--sea stars, drills, snails, and crabs
6. Algae and tiny animals eaten by larger animals
7. Where half the world's harvest of oysters is found.

Word List

gills
oyster
metamorphosis
plankton
predators
cilia
Louisiana and the Chesapeake Bay

1.	2.	3.	4.
5.	6.	7.	

#109 THE NOT-SO-COMMON OYSTER (cont.)

SUGGESTED BOOK LIST

Primary Level

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Intermediate Level

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SUGGESTED BOOK LIST (cont.)

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THE HORSESHOE CRAB

A Learning Experience for
Coastal and Oceanic
Awareness Studies

Produced by

MARINE ENVIRONMENT CURRICULUM STUDY
MARINE ADVISORY SERVICE
UNIVERSITY OF DELAWARE

and

POPULATION-ENVIRONMENT CURRICULUM STUDY
COLLEGE OF EDUCATION
UNIVERSITY OF DELAWARE

as part of a

PLAN FOR ENVIRONMENTAL EDUCATION

Fall 1974

Please send evaluations

of learning experiences

to

Dr. Robert W. Stegner, Director

COAST Project

310 Willard Hall Education Building

University of Delaware

Newark, Delaware 19711

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DEPARTMENT OF PUBLIC INSTRUCTION

DEL MOD SYSTEM

DUPONT EDUCATIONAL AID COMMITTEE

TITLE: THE HORSESHOE CRAB

*CONCEPT: I.B.4.a.(3)

I. The earth is a finite natural system.

B. All living things have arisen from and are dependent upon the natural system of the earth.

4. The interaction of organisms with their environment leads to great diversity and wide distribution of organisms.

a. Natural selection leads to evolution.

(3) NATURAL SELECTION RESULTS FROM THE INTERACTION OF INDIVIDUAL VARIATIONS WITH ENVIRONMENT.

**MARINE CONCEPT: 3.21

3. Marine organisms interact in complex ecosystems.

3.2 Marine organisms are adapted to their environments in different ways.

3.21 MARINE ORGANISMS ARE ADAPTED DEVELOPMENTALLY, STRUCTURALLY, FUNCTIONALLY, AND BEHAVIORALLY TO THEIR ENVIRONMENTS.

GRADE LEVEL: 3-6

SUBJECT: Science

PERIODS: 5-15

AUTHOR: Sachs

R576

*From A Conceptual Scheme for Population-Environment Studies, 1973. Cost $2.50.

**From Marine Environment Proposed Conceptual Scheme, 1973. No charge.

Both conceptual schemes are available from Robert W. Stegner, Population-Environment Curriculum Study, 310 Willard Hall, University of Delaware, Newark, DE 19711

INTRODUCTION

The horseshoe crab has always been a favorite animal to examine and wonder about as we beachcomb along the shore. Many of these fierce-looking but harmless animals can be found along Delaware's bayshore, especially in the spring when they are left by the receding tide to spawn. Although the great harvesting of horseshoe crabs that took place during the 19th and early 20th centuries significantly reduced their numbers, the Delaware Bay is still a major population center for the horseshoe crab. The American species is found all along the North American coast from Yucatan to southern Canada. Its only surviving relatives live along the shores of southeastern Asia and the East Indies.

The books listed in the bibliography on p. 14 are the principal sources used in writing this learning experience. Most zoology textbooks have pictures and a description of the horseshoe crab that might also be useful.

INSTRUCTIONAL OBJECTIVES

At the conclusion of this learning experience the student will be able to:

1. Describe the physical characteristics of the horseshoe crab.
2. Describe the place of the horseshoe crab in the food chain.
3. Trace the embryology of the horseshoe crab.
4. Describe the developmental processes of the horseshoe crab.
5. Relate the history of the horseshoe crab species.
6. List some economic uses of the horseshoe crab.

INTRODUCTORY ACTIVITY

Distribute copies of the poems "Thoughts of a ♂ Limulus" and "What Good Are They?" found on p. 8 . Read them silently, and then aloud. If some students do not understand all of the vocabulary used in "Thoughts of a ♂ Limulus" above average students can rewrite the poem and present their revised version to the class. Show Transparency 1.

Questions for Discussion

1. What are the general themes of the two poems?
   Horseshoe crabs have survived millions of years. They are a vital link in the food web.
2. What animal do both poems describe?
   The horseshoe crab.
3. What does the symbol ♂ mean?
   Male
4. What is implied in line 4 of "What Good Are They?"
   The horseshoe crab will outlast man.

5. Why is the horseshoe crab called a crab? Is this a correct name?
The horseshoe crab is more closely related to the spider and scorpion family. Its habitat is closely related to the "true" crab.

6. What purpose does the horseshoe crab serve?
It serves as a link in the food web.

7. What does the transparency show about the horseshoe crab?
It has not changed in 200 million years.

8. What does the transparency show about other animals?
They have become extinct or have changed greatly.

9. Why do you think there has been so little change in Limulus through the years?
He has adapted to the changes around him.

10. What do you think will happen to the horseshoe crab in the future?
It will depend on how man treats his environment.

RESEARCH AND DISCUSSION

The students can do individual or group library research to learn about the physical characteristics of the horseshoe crab. Materials listed in the bibliography on p. 14 and/or other available materials, including the horseshoe crab itself, should be used. A class discussion including the information listed below should follow to summarize what the students have learned in their research.

A. Body: 3 parts (Show Transparency 2.)
   1. Head and Thorax (Cephalothorax)
      a. The horseshoe crab has four eyes: two tiny ones on the forward part of the "shield" and one large eye on each side of the shield.
      b. The name "Limulus" means side glance or look.
   2. Triangular-shaped abdomen attached to the head by a hinge that works up and down.
   3. Spiny tail attached in ball-and-socket fashion.

B. Appendages: 6 pairs (Show Transparency 3.)
   1. The first pair is short claws or pincers.
   2. The next four pairs are legs which end in slender claws for gathering food.
   3. The last pair is legs tipped with spikes which act as "ski poles" for locomotion.
   4. The groove at the base of the legs leads to the mouth. Bristles at the base of the legs grind food (worms and soft-shell clams) as the horseshoe crab moves.

C. Reproduction

1. The spawning period is during the spring tides of May and June.
2. The female crawls up on the beach between the high and low tide marks to lay eggs in shallow depressions she makes by her burrowing movements.
3. The male crab hitches a ride on the female and fertilizes the eggs as they are deposited in each nest.
4. A female may lay a total of 20,000 eggs in several nests.

D. Embryology (Show Transparency 4)

1. Many eggs never hatch; these often serve as food for fish and birds.
2. Within a few days, the hard outer covering of each surviving egg bursts.
3. The new covering is transparent and swells to twice the size of the original covering.
4. As the embryo develops its skin is shed twice.
5. Tiny crabs are hatched within two to four weeks. The waves of the next full moon (spring) tide wash the eggs into the sea, and the eggs break as they are tumbled against the sand.

E. Growth

1. By the third year, the horseshoe crab has shed its hard outer shell 11 times and is about 6 inches long and 3 inches wide.
   a. During molting, the shell splits horizontally in front and the horseshoe crab squeezes forward out of the shell. True crabs pull out backwards from their shells when they molt.
   b. After the third year, horseshoe crabs shed once a year.
2. Horseshoe crabs migrate to deeper water until they reach the adult stage.
3. Between ages 9 and 11, the horseshoe crab matures and travels back to shallow water for the remainder of its life. Once it reaches adult stage it does not shed.
4. Females can grow to a length of 30 inches. Males are generally smaller.

F. Economics

1. The spiny tail was used by Indians for spear tips. The empty shells were used as bailers for small boats.
2. Horseshoe crabs were once dried and ground for use as fertilizer or a poultry feed supplement.
   a. 1855 - 750,000 horseshoe crabs were harvested on a half-mile stretch of beach.
   b. 1856 - 1,200,000 horseshoe crabs were collected within one mile of shoreline.
   c. Late 1920's to early 1930's - 4-5 million horseshoe crabs were harvested annually.
   d. With the use of artificial fertilizer and the reduced horseshoe crab population, harvesting horseshoe crabs has become unprofitable. The number of horseshoe crabs harvested has declined rapidly and drastically to the present time.
3. A bounty was offered on each horseshoe crab because they "endangered" the soft-shell clam.

G. Value of the Horseshoe Crab Today

1. The horseshoe crab serves as one of the many links in the food web.
   a. The eggs are eaten by fish and birds.
   b. Dead horseshoe crabs are eaten by birds and shore animals.
2. The cast-off shells serve as a source of minerals to maintain the seashore ecosystem.
3. The horseshoe crab serves as a link to prehistoric times.

ACTIVITIES

A. Language Arts

1. Have students research the historical and scientific background of the horseshoe crab on an individual or small group basis.
2. Students could write poems similar to "Thoughts of a ♂ Limulus" and "What Good Are They?" or stories about a horseshoe crab.

B. Art

1. Before the unit begins, it might be interesting for those who have never seen a horseshoe crab to make drawings of what they think it looks like.
2. Papier-maché reproductions of horseshoe crabs can be made using chicken wire as a base.

C. Field Trip

Using a spring tide forecast, plan a trip to Slaughter Beach or a beach farther south to observe the horseshoe crab. Small cast-off shells can be found showing the opening in front through which the animal "escaped" when molting. Plaster casts of the horseshoe crab's peculiar tracks can be made. Children can have an alphabetical scavenger hunt for shore items. Make sure they don't clean off the beach, and prompt them to decide to return all items to the beach.

Horseshoe crab eggs may be found by watching the birds feeding or by tracking the crab as it nests. Males will attach themselves to females as they crawl to shore to nest. The eggs are grey or green and can be put in plastic bags with sea water to bring back to the classroom.

D. Science - Horseshoe Crab Embryology

Marine salts can be purchased in a pet shop. To one quart of water, add 1.3 ounces of the marine salts and stir. Place the eggs in a shallow container with the water. This should be changed three or four times a week. The crabs should hatch in two to four weeks. Each student should observe the eggs and young crabs through a dissecting scope or hand lens every day and record his observations.

QUIZ

The quiz on p. 7 may be used to measure students' understanding of this learning experience.

Quiz Key:

I. 1. 6
2. 4
3. May and June
4. 11

II. 1. False
2. True
3. True
4. False
5. False
6. True
7. True
8. True

III. Spiny tails have been used as spear tips; empty shells have been used as tillers for small boats; dried and ground horseshoe crabs were used as fertilizer or a poultry feed supplement.

IV. The eggs and small crabs serve as food for fish and birds; dead horseshoe crabs are eaten by birds and shore animals.

QUIZ

I. Underline the correct answer. (1-4)

1. Horseshoe crabs have (6, 8, 10) pairs of appendages.

2. Horseshoe crabs have (2, 4, 0) eyes.

3. Horseshoe crabs spawn in (January and February, May and June, November and December).

4. By the third year, the horseshoe crab has shed its hard outer shell (2, 11, 67) times.

II. Indicate whether the statements below are true or false. (1-8)

_____ 1. Male horseshoe crabs are usually larger than the female.

_____ 2. Tiny crabs hatch from eggs in about 2 to 4 weeks.

_____ 3. The horseshoe crab serves as a link to prehistoric animals.

_____ 4. A female usually lays a total of about 10 eggs in several nests.

_____ 5. A horseshoe crab sheds its shell many times when it is an adult.

_____ 6. The body of the horseshoe crab is made up of three parts: the thorax, the abdomen, and the tail.

_____ 7. Horseshoe crabs have survived millions of years.

_____ 8. The horseshoe crab is more closely related to the spider and scorpion than to the "true" crab.

III. List two ways in which horseshoe crabs have been used in the past.

IV. Describe the place of the horseshoe crab in the food web.

WHAT GOOD ARE THEY?

by

John Stenger

Who'd write a poem about the horseshoe crab
Lying on the beach so dull and so drab?
Sure they've been around for two hundred million years
and when we're extinct they'll shed no tears.
What good are these creatures in armour of brown
When they clutter the beaches of our coastal towns?
Why as caviar their eggs serve birds and small fish
And small fish feed big fish that make us a dish.
So if Limulus polyphemus you meet once again,
Remember they're links in seashore food chains.

THOUGHTS OF A ♂ LIMULUS

In the Silurian age, when Eurypterus raged,
I lived with a female companion;
And little we dreamed, as we bathed in life's stream,
Of the changes proceeding in canyons.

Our long-time survival is almost sans rival
Yet we look like our fathers of old;
Our life pattern's the same, though our fellow beasts came
To adapt to time's flow, so we're told.

In time there were eels, sharks, and whales, even seals,
And we watched with a nonchalant air.
Ignoring the fashion, we lived without passion
And smiled as the faddists grew rare.

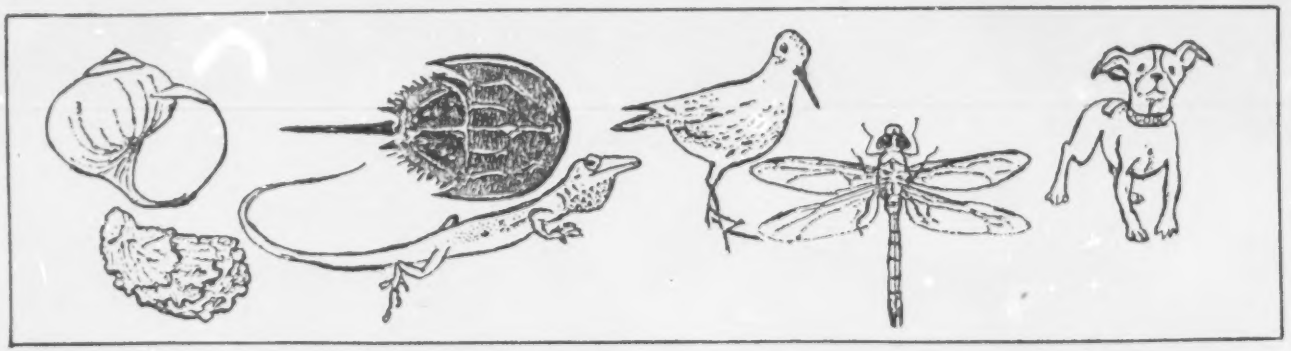
And now we still breed and scatter our seed
In the ocean's more temperate range.
Although evolution's a grand institution
Some survive while refusing to change.

Maura Geens
Woods Hole 1966
--with apologies to
the poem "Evolution"
by Langdon Smith
(1858 - 1908)

TRANSPARENCY 1

200 MILLION YEARS AGO

100 MILLION YEARS AGO

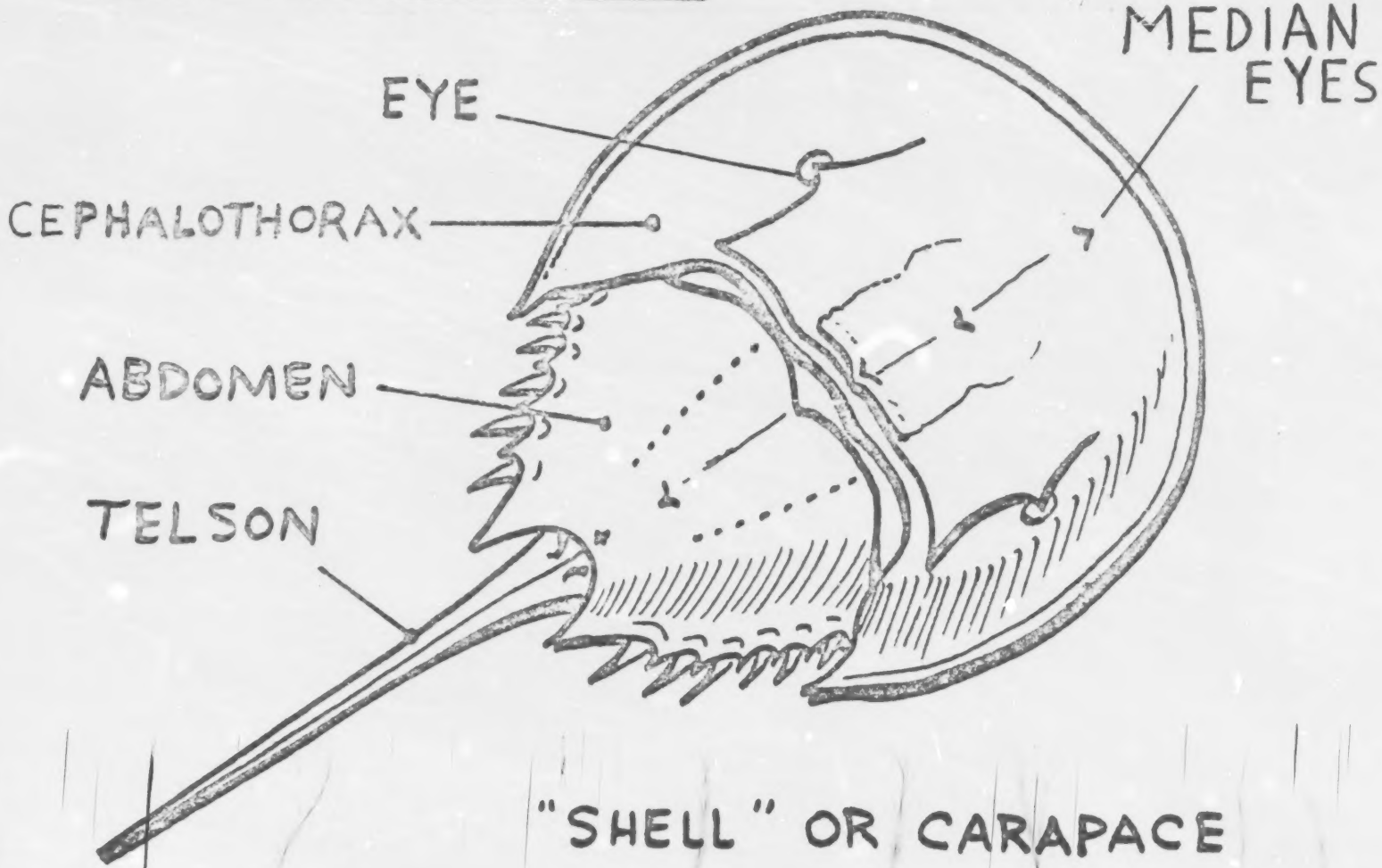


TODAY

I.B.4.a.(3)(Mar. 3.21) p. 9

TRANSPARENCY 2

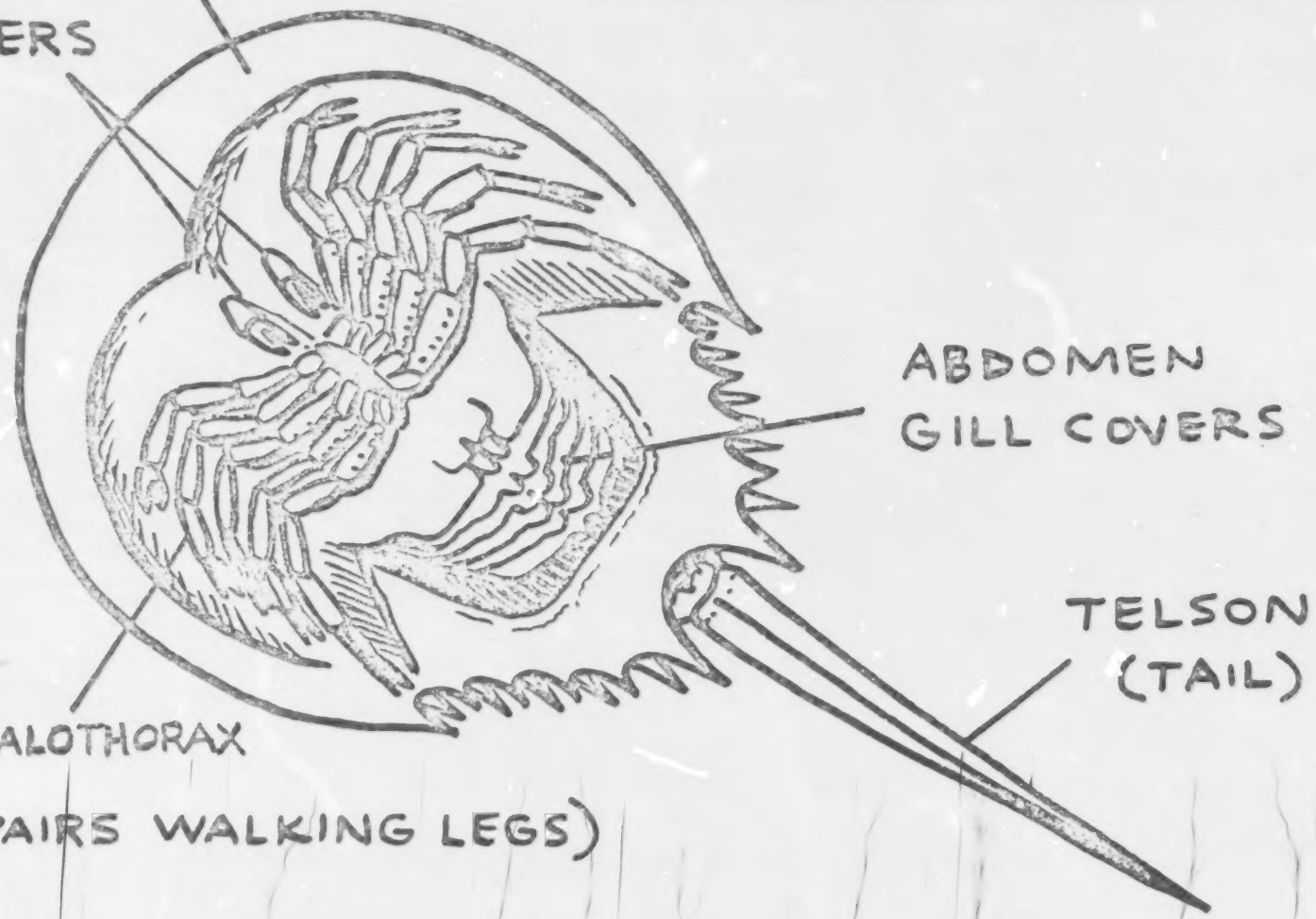
HORSESHOE CRAB



I.B.4.a.(3)(Mar. 3.21)p.10

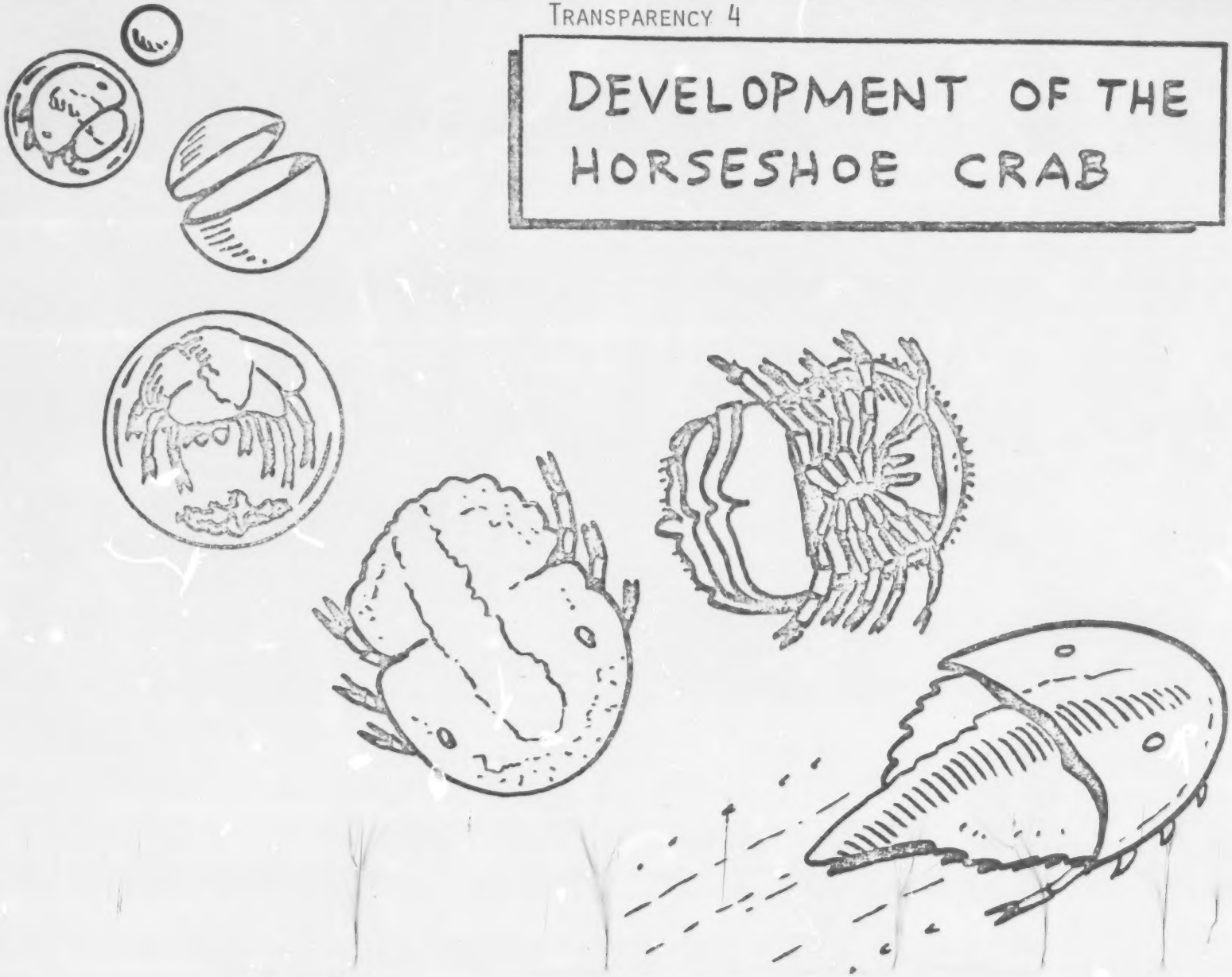
TRANSPARENCY 3

HORSESHOE CRAB



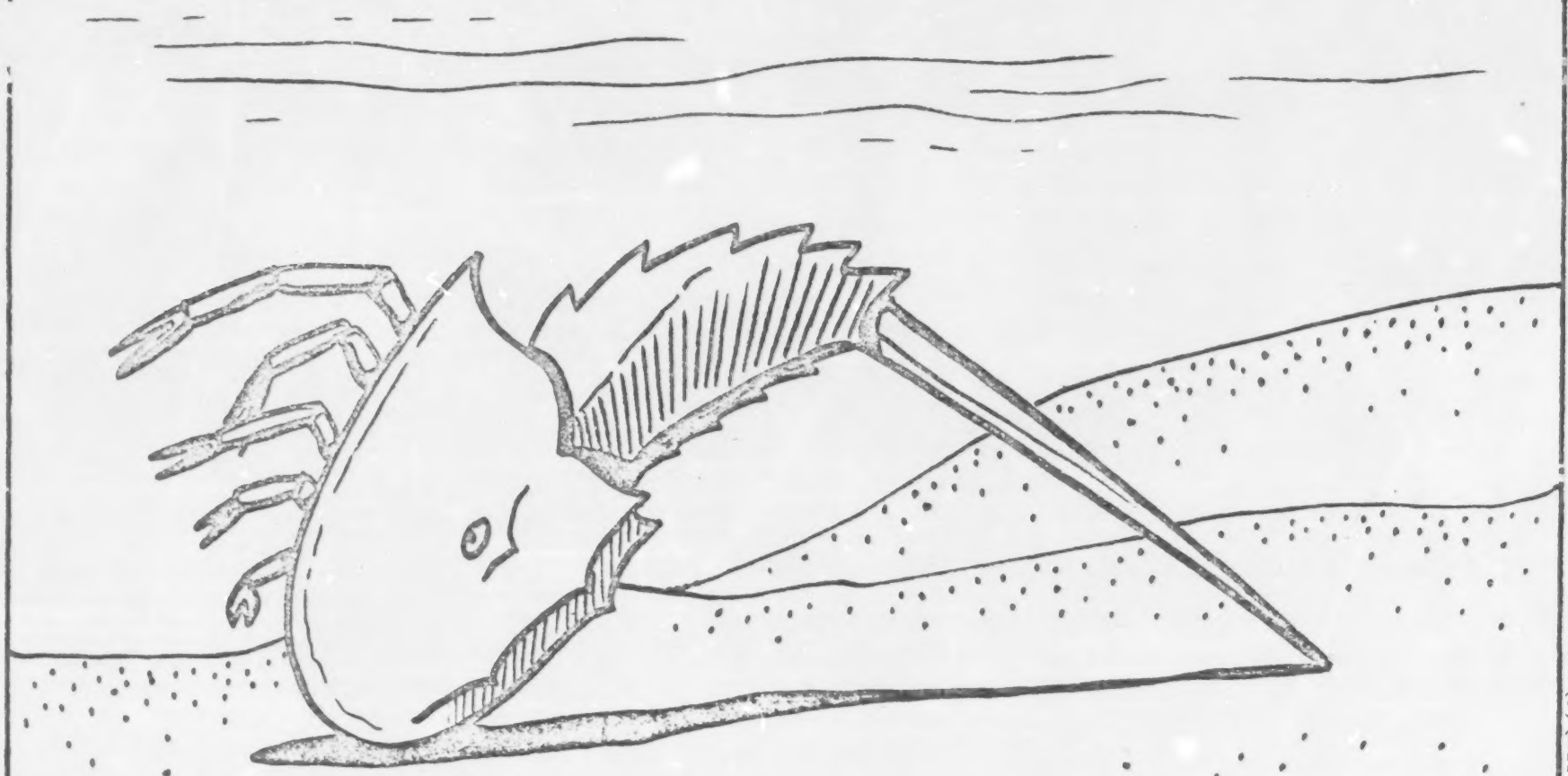
TRANSPARENCY 4

DEVELOPMENT OF THE HORSESHOE CRAB



I.B.4.a.(3)(Mar. 3.21)-p. 12

TRANSPARENCY 5



IF ACCIDENTALLY TURNED UPSIDE DOWN, THE HORSESHOE CRAB CAN TURN ITSELF OVER BY DIGGING ITS SPINY TAIL INTO THE SAND.

I.B.4.a.(3)(Mar. 3.21) p. 13

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Waters, John F. 1970. The Crab from Yesterday. Frederick Warne and Company, Inc., New York.

Language Arts Supplement

#111 THE HORSESHOE CRAB

SUGGESTED BOOK LIST

The Crab from Yesterday: The Life Cycle of a Horseshoe Crab. John F. Waters. Frederick Warne and Co.

The Edge of the Sea. Rachel L. Carson. Houghton Mifflin Co. 1955.

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Sea Shells of the World. R. Tucker Abbott. Golden Press. 1962.

See along the Shore. Millicent Selsam. Harper & Row. 1961.

The Web of Life. T. Pettit.

THE BLUE CRAB

A Learning Experience for
Coastal and Oceanic
Awareness Studies

Produced by

MARINE ENVIRONMENT CURRICULUM STUDY
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DEPARTMENT OF PUBLIC INSTRUCTION

DEL MOD SYSTEM

DUPONT EDUCATIONAL AID COMMITTEE

TITLE: THE BLUE CRAB

*CONCEPT: I.B.4.a.(3)

I. The earth is a finite natural system.

B. All living things have arisen from and are dependent upon the natural system of the earth.

4. The interaction of organisms with their environment leads to great diversity and wide distribution of organisms.

a. Natural selection leads to evolution.

(3) NATURAL SELECTION RESULTS FROM THE INTERACTION OF INDIVIDUAL VARIATIONS WITH ENVIRONMENT.

**MARINE CONCEPT: 3.21

3. Marine organisms interact in complex ecosystems.

3.2 Marine organisms are adapted to their environments in different ways.

3.21 MARINE ORGANISMS ARE ADAPTED DEVELOPMENTALLY, STRUCTURALLY, FUNCTIONALLY, AND BEHAVIORALLY TO THEIR WAYS OF LIFE.

SUBJECT: Science

GRADE LEVEL: 5-8

PERIODS: Various

AUTHOR: Kansak

*From A Conceptual Scheme for Population-Environment Studies, 1973. Cost $2.50.

**From Marine Environment Proposed Conceptual Scheme, 1973. No charge.

Both conceptual schemes are available from Robert W. Stegner, Population-Environment Curriculum Study, 310 Willard Hall, University of Delaware, Newark, DE 19711

R776

NOTE:Instructional procedures for this lesson can be found on pp. 12-14. The background information on pp. 3-9 can be reproduced as a student reading or presented, with modifications appropriate to the grade level, as a lecture.

INSTRUCTIONAL OBJECTIVES

At the conclusion of this unit, each student should be able to:

1. Differentiate between the male and female blue crab.
2. Define or identify the following:

   Trot-line
   Carapace
   Arthropod
   Decapod
   Crustacean
   Molt
   Peeler crab
   Soft-shelled crab
   Exoskeleton
   Invertebrate

3. Identify five parts on a blue crab.
4. Demonstrate how to catch blue crabs during a field trip.

The Blue Crab

Background information

I. Introduction

The largest group in the animal kingdom is the Phylum Arthropoda, or animals with jointed legs.

The blue crab belongs to the class of arthropods known as Crustacea.

The body of the blue crab is divided into the cephalothorax, made up of the head and thorax, and the abdomen.

The blue crab is an invertebrate with an exoskeleton, or outer skeleton, consisting of a flexible substance called chitin. The chitin becomes impregnated with calcium carbonate, the principal component of limestone. This results in a tough, crust-like shell, from which crustaceans derive their name. (The Latin word crusta means crust, or shell.)

The blue crab is distinguished from other crustaceans, such as the lobster,by the small abdomen which is folded up under the body. It has five pairs of legs. The first pair end in pincers and are larger than the rest. The last pair of walking legs are often flattened and are used for swimming. Crabs usually walk, crawl, or swim with a sideways motion. Because of the number of legs, the blue crab is placed in the Order Decapoda (ten-footed) .

II. Where does the blue crab live?

The blue crab is found in the Atlantic coastal waters and in estuaries from Boston to Brazil. It is commonly found in

the Delaware Bay and in the Delaware River as far north as New Castle, Del.. The blue crab is a bottom dweller. It will bury itself in the sand or mud either for protection or to conceal itself in order to surprise its prey. Blue crabs will also hide among seaweed or rocks. The blue crab will hibernate in the lower reaches of the bays in muddy sand and weedy bottom during the winter.

Places where the blue crab is abundant:

Rehoboth Bay
Indian River Bay
Indian River
Assawoman Bay
Chesapeake Bay
Chincoteague Bay
Mispillion River
Lewes and Rehoboth Canal
Love Creek
Pepper Creek
White's Creek

III. Reproduction in the blue crab

All blue crabs reproduce, as do vertebrate animals, by the union of two sexes. The female can only mate during the molting period (doublers are two crabs together, one carrying the other). The female has a special organ called a sperm receptacle, where she stores the sperm from the male until the eggs are ready to be deposited. The female carries the eggs after extrusion until they are hatched. She is

called a sponge crab during this period. The eggs usually are cemented in bunches to the swimmerets and one female may carry from 3,000 to 100,000 eggs.

The young go through a metamorphosis and after hatching bear very little resemblance to the adult. The little crab is called a zoea larva. The zoea has a tiny, rounded body which is unsegmented but bears three pairs of movable appendages. All of these appendages serve to propel the larva through the water.

The length of time required for a typical decapod to grow from a zoea larva to maturity is about 208 days. It is estimated that during that period a crab will molt more than fifteen times and grow from a width of one twenty-fifth (1/25) of an inch to seven inches. The life of a blue crab extends over a period of three years or more.

IV. How does the blue crab grow?

The blue crab is completely enclosed in a more or less continuous hard-shelled covering, hinged like a suit of armor. This hard shell is incapable of expansion so in order to accommodate increased size due to growth the crab has to shed its shell from time to time. It does this by backing out of its shell where the carapace and abdomen join together.

The blue crab gives warning of an approaching molt several days in advance. A black line appears just within the back margins of the outermost segments of the swimming legs. This line changes to white and then to red two or three days before the molt. If the inner substance recedes when the paddle of the swimming leg is squeezed, an approaching molt is indicated.

Fishermen call the crab in this condition a "peeler".

At the moment of molting the top shell (carapace) begins to move away from the abdomen and a crack appears in each side of the shell going almost to the mouth. The back part of the body begins to stick out through the gap. At this time the crab usually lies motionless, but it can swim quite actively if disturbed. The remainder of the molting process requires about fifteen minutes. The carapace is lifted higher, the swimming legs begin to be withdrawn.

When the crab has freed itself completely from its old shell, it is that table delicacy known as soft-shelled crab. This is the only time that the female can be impregnated. The crab remains soft for a short time only, for within 48 hours the new shell has hardened. The hardening of the shell is due to the deposition of lime salts. Normally all crabs seem to eat discarded housing immediately after molting. This may be the source of the lime salts needed for rapid hardening of the new shell.

Molting is an exhausting process and dangerous as well because the crab is defenseless at this time.

V. How does the blue crab locate food and eat it?

The blue crab seems to have only two kinds of organs of special sense: a pair of eyes and sensory hairs or setae distributed over parts of the body and appendages. Though the eyes are prominent because of their size and their position on stalks which may be drawn into the cephalothorax, the crab's vision may not be very keen and not very useful in bright light. Like the eyes of insects, those of the

crab are compound, with perhaps as many as 14,000 facets.

The function of smelling is performed by the olfactory setae, which are found on the first antennae and mouth parts. These hairs are sensitive to chemical stimuli. As the currents waft fine particles from live prey or from decaying organic matter these olfactory setae catch the scent and lead the crab to its food.

The blue crab uses it pincers to rip and tear its food and push it into its mouth.

The blue crab's stomach consists of two chambers. The chitinous lining of the cardiac chamber is thickened to form a system of plates or "millstones" which by muscular action engage with three strong teeth set in the narrow opening between the two chambers to grind up the food ingested. This apparatus is called the "gastric mill". In the second, or pyloric chamber the food particles are mixed with secretions from digestive glands.

VI. Regrowth of limbs

A crustacean can cast off a limb and grow a new one in its place. This serves as a means of escape from its enemies. Such a voluntary break in the crustacean's appendages occurs at a "fracture plane" in the second joint of the limb where it is immovably fused with the third joint. At this point the internal cavity is crossed by a transverse partition with a small opening through which the nerves and blood vessels pass but not the muscles of the leg. The crustacean produces the break by a spasmodic contraction of the muscles. The partition facilitates the formation of a blood clot and this stops the bleeding. The growth of a

new limb begins at once with the formation of a bud beneath the scar left by the breaking off of the old one. The bud takes on the shape of a limb, indistinguishable from its predecessor usually after a few molts.

VII. The blue crab as food for man

The blue crab fisheries of the Chesapeake Bay region yielded a catch of over 74,000,000 pounds in 1961.

Formerly blue crabs were caught on trot-lines. These were long lines with baited leaders, laid on the bottom where crabs would overrun them. When the crab took hold of the bait, it would be drawn to the surface and dip-netted into a boat. Today commerical fisheries use more crap pots or traps than trot-lines.

In the Chesapeake Bay in winter months the blue crabs withdraw to the lower reaches of the Bay, to more or less hibernate in the muddy sand and weedy bottom. During this time metal dredges are used to drag up the crabs.

Crabs may be placed in crab cars or crab floats to await molting. The crab car is divided into sections. The crabs are checked for molt indicators and put into appropriate compartments. When the molt occurs the crabs are collected and iced or frozen and sold as soft-shelled crabs.

VIII. Glossary of Terms

Arthropod- an animal belonging to the Phylum Arthropoda, characterized by jointed appendages, a segmented body and a chitinous exoskeleton.

Crustacean- an animal belonging to this Class of arthropods, whose members mostly live in water and breathe by means of gills or the passage of water through their skins; many have a shell. Crabs, lobsters, and shrimps are crustaceans.

Decapod- means literally having ten feet, members of that Order of Crustacea to which the blue crab belongs.

Cephalothorax- a body division consisting of head and thorax.

Invertebrates- animals without backbones.

Vertebrates- animals with backbones.

Exoskeleton- the hard outer covering of an invertebrate animal such as in the lobster or crab.

Molt- the process of shedding a shell to accommodate new growth.

Peeler crab- a crab that is a day or two away from a molt; widely used as bait by fishermen.

Zoea larva- larval stage of a decapod crustacean

Chitin- flexible substance of exoskeleton which becomes impregnated with calcium carbonate.

Trot lines- lines a mile or more in length with short baited leaders, approximately six feet apart, that touch bottom. A boat goes from one end to the other checking the baited lines for crabs which are then dip-netted.

Dredge- machine used for gathering oysters, clams, crabs, etc, from the bottom of a river or bay.

Carapace- the top shell of a crab.

Gastric mill- that structure in the two-chambered crustacean stomach which breaks the food up into small particles.

Setae- sensory hairs responsible for the sense of smell and the sense of touch in crustaceans.

Pre-and post-test on the blue crab

Underline the correct answer in 1-10.

1) Blue crabs have (6, 8, 10) legs.

2) Blue crabs are (vertebrate, invertebrate) animals.

3) Blue crabs are (land, water) animals.

4) Blue crabs breathe by means of (gills, lungs).

5) The blue crab locates its food mainly by (smell, sight).

6) A single female blue crab will produce (1-2, 5-10, 20-50, 3,000-10,000) eggs in one season.

7) Blue crabs (die, hibernate) in the winter.

8) Blue crabs are found in (fresh, salt) water.

9) A normal life span for a blue crab would be (1, 3, 5, 10) years.

10) Blue crabs are (poisonous, edible).

Indicate whether statements 11-20 are true or false.

11) It is not possible to tell the difference between a male and female blue crab by looking at the shell.

12) If a blue crab loses a leg, it can grow a new one.

13) A blue crab must shed its shell in order to increase in size.

14) A sponge blue crab is a soft-shelled crab.

15) A peeler crab is a crab with a disease.

16) A blue crab is a crustacean.

17) A blue crab is an arthropod.

18) A blue crab is a decapod.

19) The main enemy of the blue crab is man.

20) A blue crab larva goes through a metamorphosis like some insects.

Answers to pre-and post- test

1. 10
2. invertebrate
3. water
4. gills
5. smell
6. 3,000-10,000
7. hibernate
8. salt
9. 3
10. edible
11. False
12. True
13. True
14. False
15. False
16. True
17. True
18. True
19. True
20. True

Instructional Procedures

I. Introducing the unit

A. Give the pre-test. (p. 10)

B. Show the transparency of the blue crab. (p. 16)

C. Ask the questions below to stimulate discussion and interest.

1. How many of you have eaten blue crabs?
2. Where did you obtain the crabs you ate? Did you buy them or **catch** them yourself?
3. How many of you have ever gone crabbing?
4. How did you catch the crabs?
5. How were the crabs eaten?
6. What happens to the color of the shell when it is cooked?
7. What do crabs eat?
8. What devices are used to catch crabs? Show the transparency Devices for Catching Blue Crabs on p. 18.

In discussing these questions the students will reveal what factual information and misconceptions they have about the blue crab.

D. Show the transparency of the underside view of the shell of the male blue crab and female blue crab. How are the two sexes differentiated? Note the abdominal plate on the undersurface of the shell. (Transparency is on p. 17)

II. Activities

A. Ask the class to look for information about the blue crab in newspapers, magazines, and other sources.

B. Take a field trip to Rehoboth Bay.

1. Collect blue crab specimens and bring them back to the classroom. Sort the crabs into males and females, and then sort them into the following categories:

a. Peeler crabs
b. Soft-shelled crabs
c. Sponge crabs
d. Hard-shelled crabs

2. Make and tend a short trot-line.

3. Inspect the habitat of the blue crab.

4. Observe how the blue crab protects itself.

C. Take a field trip to a crab processing plant to see how crab meat is prepared for market.

D. Divide the class into groups. Each group will write to one of the Atlantic Coast states asking for information on the commercial crab industry and laws protecting the blue crab in that state. Other group activities might be to:

1. Compare Delaware's laws with those of other states.
2. Make a graph comparing the pounds of crab meat harvested in Delaware with the pounds of crab meat harvested in other states.
3. Make a graph showing the blue crab's place in the total seafood harvest in the United States.
4. Make a chart showing the life cycle of the blue crab.

E. Start a salt water aquarium with the blue crab as its only inhabitant. Observe the crab as it molts, finds food, and eats. Find out what kind of food the crab prefers. (For information of setting up a marine aquarium, see learning experience I.B.4. [Mar. 3.2] "Marine Aquaria" available from Population-Environment Curriculum Study, 310 Willard Hall, University of Delaware, Newark, DE 19711.)

F. Dissect a peeler crab to demonstrate that when the old shell is shed there is a new flexible one to take its place.

G. Review information covered in the Background Information, using the list of points to be covered below and on p. 14.

H. Give the post-test. (p. 10)

Specific Points of Information to Be Covered in Classroom and Field Activities or in Student Group Research.

1. What is the largest group in the animal kingdom?
(Arthropods)

2. What does the word arthropod mean?
(Animals with jointed feet.)

3. The blue crab belongs to a group of animals having a crust-like shell. What is this group called?
(Crustaceans)

4. How many major divisions does the body of the blue crab have?
(Two, the cephalothorax and abdomen.)

5. What is an exoskeleton?
(An outside or external skeleton)

6. Is the blue crab a vertebrate or an invertebrate?
(An invertebrate)

7. What does the word decapod mean?
(10-footed)

8. How many legs does the blue crab have?
(10)

9. The first pair of legs on the blue crab is larger than the rest. What is the first pair called?
(Pincers)

10. What is the last pair of legs on a blue crab used for?
(Swimming)

11. Where is the blue crab found?
(In the Atlantic coastal waters and coastal estuaries)

12. What does the blue crab do in winter?
(Hibernates in the muddy sand of bays)

13. The blue crab is a bottom dweller.

14. How does the blue crab protect itself?
(Uses its pincers defensively or digs into the sand or mud to hide.)

15. The blue crab goes through a metamorphosis as do certain insects.

16. How long does the blue crab usually live?
(3 years)

17. A female crab carries her eggs until they hatch.

18. What does the word molt mean?
(Shedding a shell)

19. What is the top shell of the blue crab called?
(Carapace)

20. What is a peeler?
(A crab that is about to molt)

21. What is a soft-shelled crab?
(A crab that has just molted)

22. How long does a blue crab stay soft?
(For only a short while; it will be hard within 24 hours)

23. What do most crabs do with their old shells?
(Eat them)

24. Why is molting a dangerous time for the blue crab?
(The crab is defenseless at this time.)

25. What are setae?
(Sensory hairs)

26. The eyes of the crabs are on stalks.

27. What kind of eyes do blue crabs have?
(Compound eyes)

28. What are trot-lines?
(Long lines with baited short lines attached; used to catch crabs.)

29. How are most blue crabs caught commerically today?
(With crab traps or by the use of dredges)

30. If a blue crab loses a leg, can it grow a new one?
(Yes)

31. A crab can cast off a leg to escape an enemy.

32. How long does it take a crab to grow a new leg?
(The time required for a few molts.)

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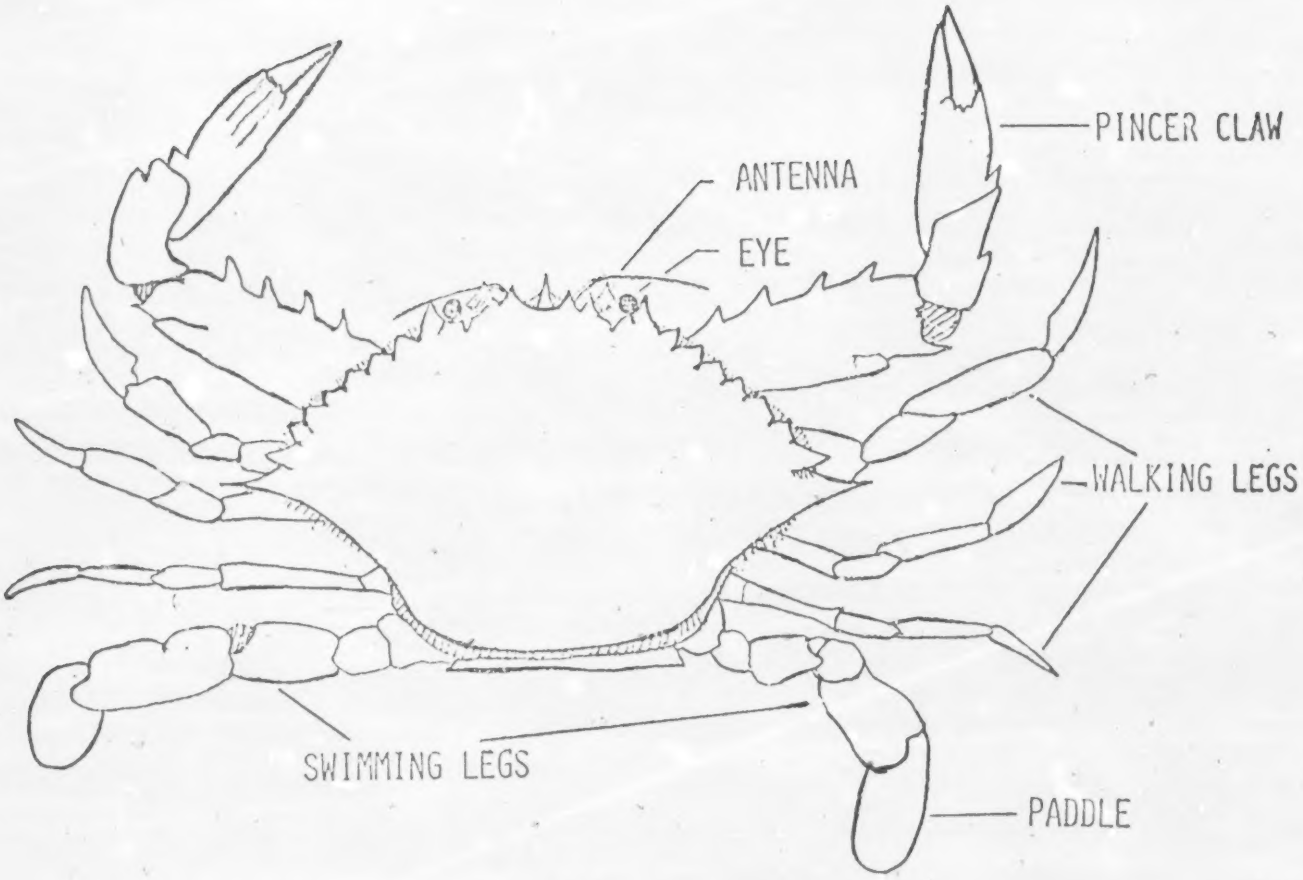
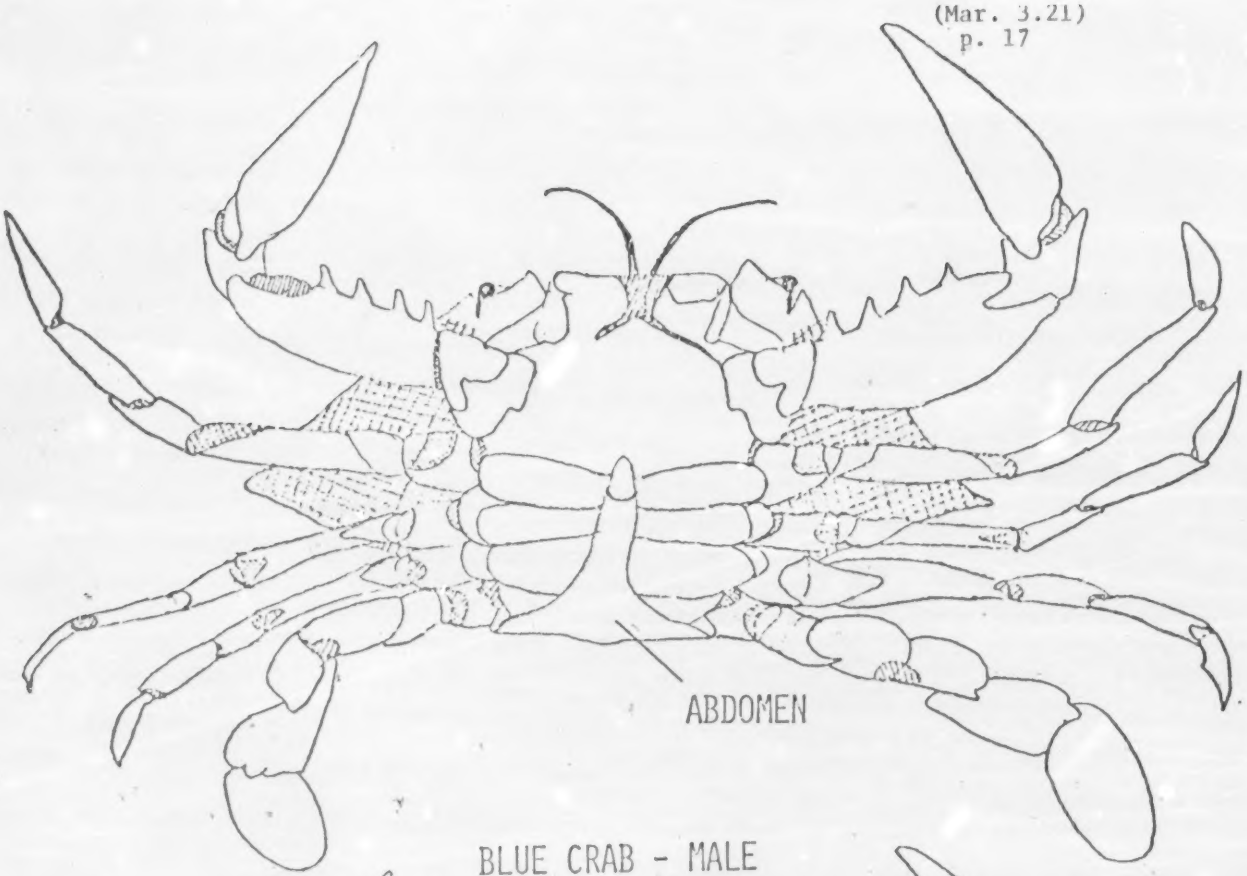
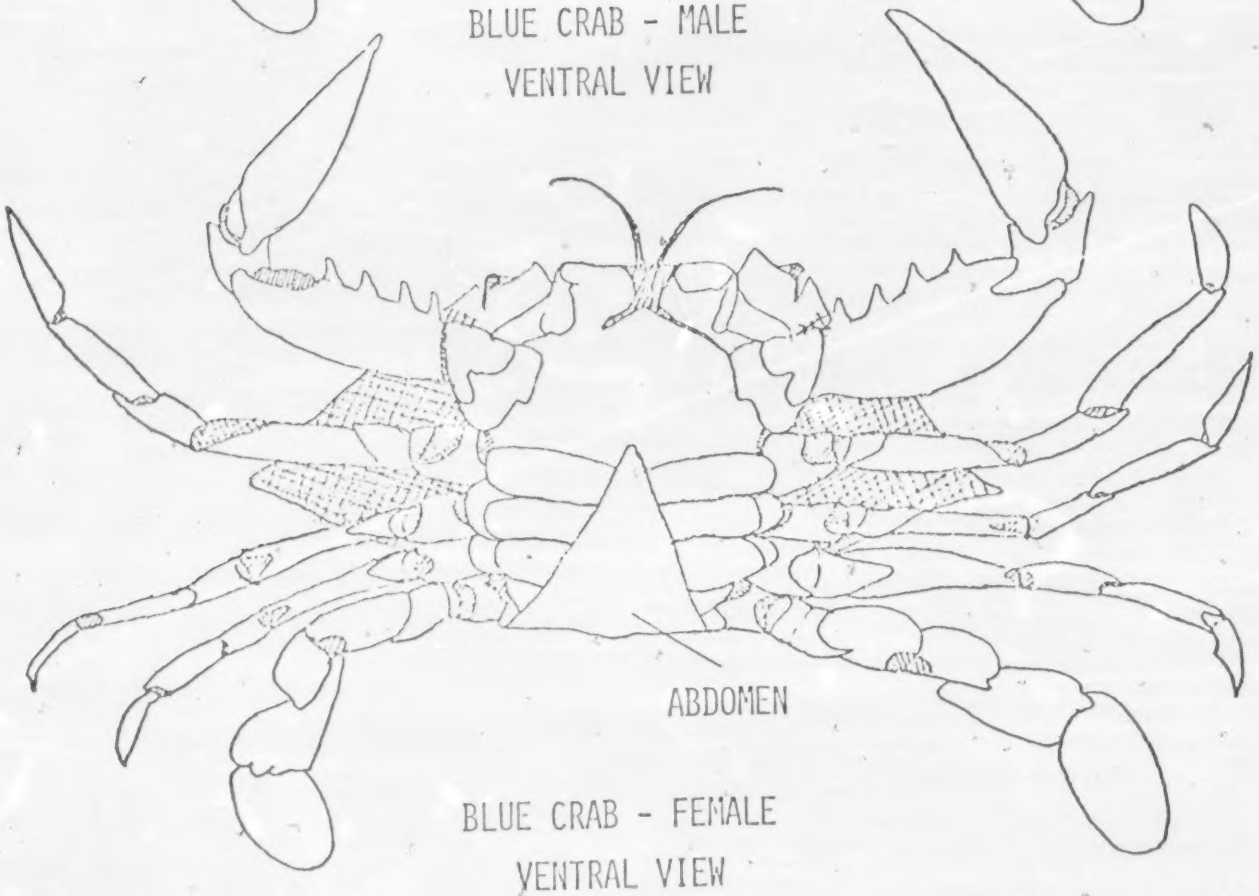


BLUE CRAB
DORSAL VIEW

WSE



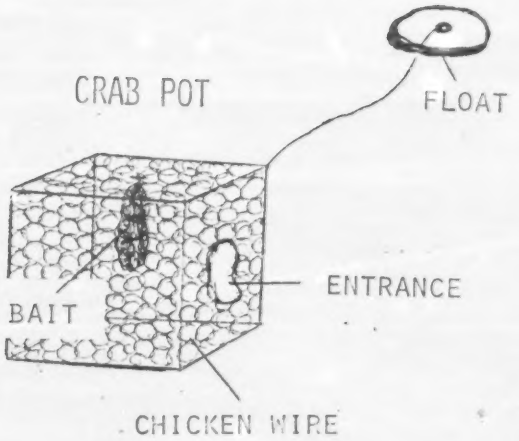
BLUE CRAB - MALE
VENTRAL VIEW

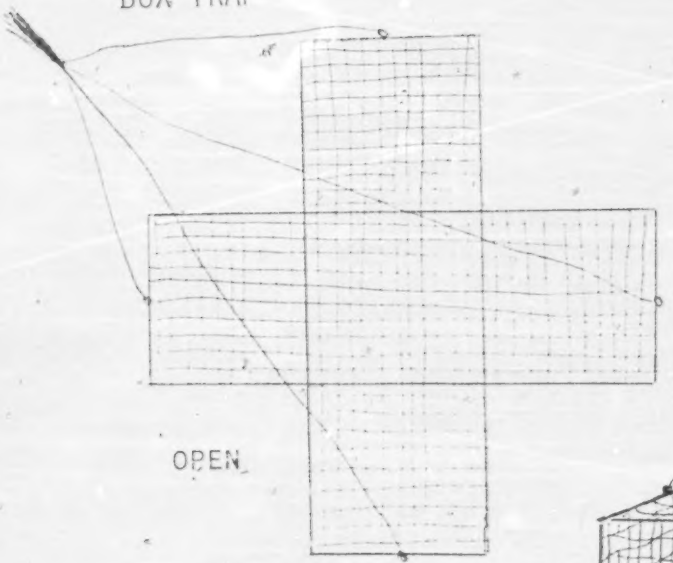


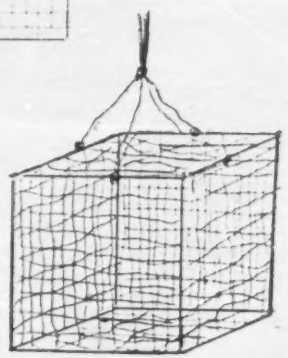
BLUE CRAB - FEMALE
VENTRAL VIEW

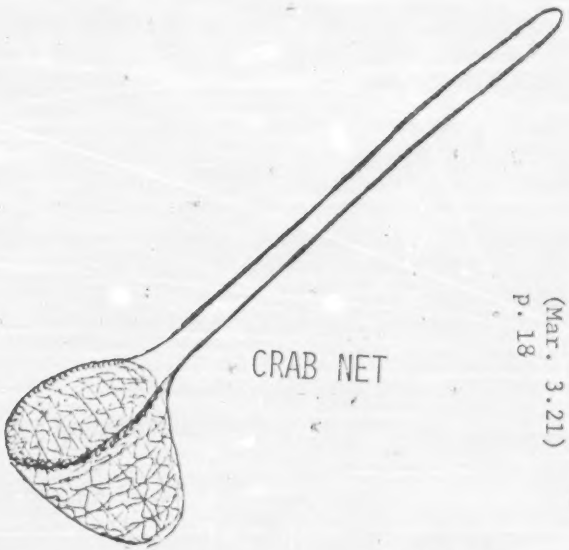
HSE

DEVICES FOR COLLECTING BLUE CRABS









Language Arts Activities Supplement

#201 THE BLUE CRAB

Grades 5-8

Cinquains

Make copies of the handout on the following page and give each student a copy. Instruct them to use the facts about the blue crab to write a cinquain. After they have written their poems, have the students read their poems to the class.

SUGGESTED BOOK LIST

The Beachcomber's Book. Bernice Kohn. The Viking Press. 1970.

The Beachcomber's Handbook of Seafood Cookery. Hugh Zachary. John F. Blair, Publisher. 1969.

Harvesting the Sea. D. X. Fenten. J. B. Lippincott Co. 1970.

How to Know the American Marine Shells. R. Tucker Abbott. The New American Library. 1961.

The Life of the Seashore. William H. Amos. McGraw-Hill. 1966.

Man Explores the Sea. Malcolm E. Weiss. Julian Messner. 1969.

Nets Overboard! Jack Coggins. Dodd, Mead & Co. 1965.

Sea and Shore. Clarence J. Hylander. The Macmillan Co. 1950.

The Sea around Us. Rachel Carson. Franklin Watts, Inc. 1961.

The Sea for Sam. W. Maxwell Reed and Wilfrid Bronson. Harcourt Brace Jovanovich, Inc. 1960.

WRITING CINQUAINS

Have you ever written a cinquain? A cinquain is a form of poetry made up of only five lines and twelve words.

Line 1 - Title
Line 2 - Two words describing title
Line 3 - Three words (action word--a verb)
Line 4 - Four words (a feeling about line 1)
Line 5 - One word (a synonym for the title)

Use the facts about the blue crab given below to write a cinquain.

The Blue Crab

_____ _____

_____ _____ _____

_____ _____ _____ _____

Facts about the Blue Crab

The blue crab (Callinectes sapides) is an edible crab found from Cape Cod to Florida.

It lives on the bottom of quiet bays and tidal rivers and can be found on either sandy beaches or rocky shores.

The blue crab differs from most crabs in that it is a good swimmer and sometimes can be found near the surface of the water among floating seaweed.

Its swimming proficiency comes from flattened paddle-like growths on its last pair of walking legs.

The blue crab's carapace (a hard shell-like covering) is twice as broad as it is long, reaching a breadth of six inches. The blue crab can be recognized by the stout spine on each side of the carapace.

When fighting, the blue crab uses its claws as weapons.

The blue crab is a gaily colored crustacean--green on its upper surface, white or yellowish on its underside, with blue walking legs and claws tipped with red.

During the molting season, the blue crab is known as the soft-shell crab.

Description

ten jointed legs

width of body is greater than its length

abdominal flap tucked under at rear

two eyes on stalks

complicated mouth--parts constantly moving

last pair of legs end in paddles, making blue crab strong swimmer